

**17th
Annual**

Connecticut STEM Fair

Saturday, February 4, 2017

Sponsored by:



Inspiring and Educating Students

CTSTEMfoundation.org

Fair Schedule 2017

7:30 am:

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

8:30 am:

Exhibitor Check-In (Athletic Entrance)
Breakfast (Cafeteria) and
Set-Up (North and South Gymnasiums)

9:30 am – 12:30 pm:

Judging of Exhibits (North and South Gymnasiums)

12 pm – 1:30 pm:

Fair Exhibits Open to Public (North and South Gymnasiums)
Lunch for Exhibitors & Judges (Cafeteria)

1:30 pm:

Keynote Presentation by
Dr. Stephanie Eisenbarth (Auditorium)

Followed by Awards Ceremony

Keynote Speaker

17th Annual Connecticut STEM Fair



We are honored to welcome **Dr. Stephanie Eisenbarth**

We are pleased to announce that our Keynote Speaker at this year's Connecticut STEM Fair will be Stephanie Eisenbarth (MD, PhD) Assistant Professor of Laboratory Medicine, of Immunobiology, and of Medicine from Yale University School of Medicine.

How the immune system goes awry to cause disease has long intrigued her. Educated at Bryn Mawr and Yale, Dr. Eisenbarth runs a research and clinical lab at Yale. Her research focuses on how a unique population of sentinel cells of the immune system, called dendritic cells, initiates both protective and harmful immune responses. Dendritic cells survey tissues for infection or damage and translate this information into signals that regulate the activation of T cells to drive inflammation. They study this in the context of several disease models including allergy, alloimmunization to transfused red blood cells and the protective immune response generated by vaccines.

Her clinical work focuses on the diagnosis of food allergy and autoimmunity. She is trained as a Clinical Pathologist and as such, combines her clinical and research interests in her daily work as a physician-scientist.

Dr. Eisenbarth will discuss her personal background, training pathway and the joy and challenges of her career to give our young scientists greater insight and understanding to what lies ahead on the road to becoming professional research scientists.

Special Thanks

The Connecticut STEM 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 Connecticut STEM Foundation 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 the Foundation to fund the enrollment of teachers from a variety of schools and districts in a program enhancing their ability to teach science research effectively.

Sexauer's support this year has allowed us to triple the monetary awards given to deserving students, plus support two college scholarships towards freshmen year expenses.

Our thanks go out to this visionary benefactor.

Acknowledgements

The Connecticut STEM Foundation, Inc., gratefully acknowledges these generous contributors:

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Scholarship Program and ISEF:
Sexauer Foundation, Inc.**

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Yale New Haven Hospital

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Robert Susalka, CPA

The Connecticut STEM 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 200 judges, 40 individuals who prepare materials for the fair; 25 who assist with fair day activities, and the members of the Connecticut STEM Foundation Board of Directors who manage the fair.

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

We acknowledge in a special way the Faculty and Staff of Darien 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 Their Endless Hours of Service:

Ziaul Mannan: Fair Coordination
Fran Walker-Lichtenberg: Judging Coordination
Dr. Nathan Davis: SRC member
Dale Lichtenberg: Logistical Coordination
Dave Lewis: Darien High School Science Teacher
Joop de Groot: Software Development
Dr. Shari Meyers: SRC Chair
Dr. A.J. Scheetz: Registration Coordination
Rita Smircich: Program Booklet Coordination

For Their Dedicated Service on the Day of the Fair:

The Board of Directors of the Connecticut STEM Foundation

Tabulation Room Volunteers:

Joop de Groot
Rob Grosso
Bob Susalka

For Their Dedicated Service:

Our Talented and Hard-Working Judges (as of 1.24.2017)
Satya Achanta
Dorothy Adams
Chirag Adhia
Law Ager
MD Kaimul Ahsan
Bruce Allen
Kathy Almeida

Ben Alper
Herbert Auslander
Sundararajan Balaraman
Dianna Bartel
Steven Baumann
Rick Benson
William Berson
Brian Bethel
Carl Binner
Marco Boccitto
Larry Bowman
Maura Bozeman
Randall Bright
Dave Caianello
Jose Carballo
Nicolas Carrasco
Joseph Carraway
Prakash Chakravarti
Paula Chapla
Ty Chatchaidech
Stavros Christofi
James Corbier
Robert Cordery
P.J. Corrales
Jesslynn Crowson
Kelly Crusio
Fred Cunningham
Craig Cuttner
Greg D'Andrea
Cheryl Damiani
Nathan Davis
Frank DiCristina
Mark Dinning
Michael Doery
Arthur Doweyko
Anna Duran
Sophie Dutheil
Garrett Ebersole
Lisa Fanti
Linda Farber
Joseph Farnyiarz
Kathleen Fearon
John Feder
Anthony Fiumidini
John Fleming
Kevin Gildea
Frances W. Ginsburg
Ken Goldman
Ken Goodall
Nicolas Greco
Marshall Greenspan
Joseph Grills

Krishna Gupta
Barry Hammons
Sanjeev Handa
Amy Handmaker
Joseph Hendrick
Aaron Herold
Nicholas Herrel
Patty Heyl
Dave Hill
Jacqueline Hojnacki
John Honey
Shafaet Hossain
Wayne Howell
Qiang Hu
Shahidul Islam
Haya Jamali
Ron Janis
Adel Joobeur
Andy Judge
Josh Karges
Mat Kastner
Betty Klein
Craig Knebel
Rajeswari Kompalli
Alexander Kremer
Nanda Kumar
Lillian Labowsky
Michael Labowsky
Jean Larson
Tom Larson
Marc Lash
Barry Lawless
Oscar Leiva
Thomas Liaskas
Samantha Lin
Wilson Lin
Bob Logano
Isaac Macwan
Jim Magid
Piet Marks
Steve Marlin
Kent Marshall
Ramon Martinelli
Mark Mathias
Brian McCabe
Dave McCullough
Robert McDougal
Kaori McManus
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Ruth Montgomery
Alex Moore
Jacqui Lombard Morrison

Nina Morrisson
Thomas Morrisson
Carl Mueller
Qi Ni
Paul Oestreicher
Michael (Mike) Ogrinz
Thompson Okumodi
Georgina Pappas
Thomas Parson
Prabir Patra
Larry Perlstein
Devin Peuser
Luu Pham
Rick Phillips
Jeff Pierce
Karen Pierce
Nick, Jr. Pizarro
Bill Poirier
Sharath Prabhakar
Michael Rafa

Atif Rakin
Or Rikon
Forest Robertson
Alina Romero
Stephen Roux
Andrea Ruskin
Karin Russo
Marie Sabo
James Saulnier
Arpan Savla
Joshua Schwartz
Cary Shaw
Taku Shimura
Emilie Shine
Beth Siegelbaum
Deirdre Silberstein
Steve Simons
Ray Skorupa
Ken Spelke
Davi Squizzato

John Sterpka
Brian Thompson
Carol Tomczyk
Thomas Tyler
David Valovich
Karen Varco
Jessica Verbisky
Bob Wagman
Kasey Wagoner
Lee Warren
Thomas Weinlandt
Jim West
Daniela White
Michael White
Geoffrey Williams
Kim Wolcott
Robert Wood
Jonathan Yarmis
Philip Zuckerman

We would like to thank
Estelle Fanucci
for her foresight and
generous support in
spearheading our
scholarship programs.



The **Connecticut STEM Foundation, Inc.** is a non-profit organization. Your financial contribution, of any amount, is greatly appreciated. Our goal is to expand our Fair to include students from other areas of Connecticut, create educational programs, and lecture series, and increase our annual awards and scholarships.

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

If you'd like to make a tax-deductible donation, or volunteer to help us reach our future goals, please contact us at CTSTEMfoundation.org, or send us an email to info@CTSTEMfoundation.org, or donate directly via PayPal at <https://www.paypal.me/CTSTEM>.

Thank you for your support!

How to Contact Us:

The Connecticut STEM Foundation, Inc.

PO Box 1048, Redding, CT 06875

203-978-3689

www.CTSTEMfoundation.org

info@CTSTEMfoundation.org

You can find us on Facebook and LinkedIn



The Connecticut STEM Foundation, Inc. (CTSTEM), an IRS Sec. 501(c)(3) non-profit organization, seeks to inspire and educate students by encouraging inquiry and exploration in science and engineering, and by exposing them to exciting and practical advances in science. In addition to sponsoring the Connecticut STEM Fair (CTSTEM Fair, www.ctstemfair.org) each year, CTSTEM has held some extraordinary events for students to see the practical application of science, including 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 us at our web site at CTSTEMfoundation.org.

***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 Connecticut STEM Foundation’s Science Fair.



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"I can, I will, I am."

-Denis Waitley



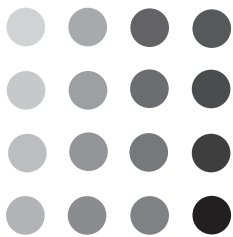
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The Board of Directors of
Connecticut STEM Foundation, Inc.

would like to congratulate

The Sexauer Foundation

recipient of this year's

Paul Heilman Award

The dedication of the Sexauer Foundation
in supporting the

Connecticut STEM Foundation, Inc.,
its fairs, scholarships and students over
the years has shown its commitment to
the STEM education of the
Connecticut students.

Congratulations on a very well deserved
Award, and much appreciation for the
tremendous support.





The Connecticut STEM Foundation, Inc.
would like to thank the

Office of Naval Research

for their generous support of our
Connecticut STEM Fair by providing
five Awards to deserving students.



The Board of Directors, and the Advisory Board would like to extend our
deepest heart-felt appreciation to

The Sexauer Foundation, Inc.

for their continuous support of our Foundation. This year, the Sexauer
Foundation are proud sponsors of the Health, Environmental and
Behavioral Science Awards. Plus the two college scholarship awards
to graduating seniors are given on behalf of the Sexauer Foundation.





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About the Connecticut STEM Fair

The Connecticut STEM Fair, organized by the Connecticut STEM Foundation, has reached a new milestone by becoming a regional affiliate of the International Science and Engineering Fair (ISEF). Last year, ISEF, known as “the Olympics of Science Fairs”, offered to about 1,700 high school students, from more than 75 countries, regions, and territories, the opportunity to compete for approximately \$4 million in prizes. This year 3 additional students from Connecticut will not only be eligible to compete at ISEF, their trip will be fully supported financially by funds raised by the Connecticut STEM Foundation, Inc. Founded in 2001, the Foundation held its first fair in a Westport church basement, with eight enthusiastic high school students. Last year the fair was held at Darien High School and had over 225 student participants, and almost 300 volunteers, including nearly 200 judges.

The Connecticut STEM Fair continues its tradition of comprehensive judging and interaction between the stu-

dents and professionals. In order to complete its mission, the Fair promotes critical thinking skills and motivates students to pursue post-high school science and engineering education. Students receive individual awards in four scientific categories: health, physical, environmental, and behavioral. Within each category, awards are given for both completed projects and research proposals. There are also two team categories: research proposals and completed projects. In addition, the Office of Naval Research will sponsor five awards that will go to projects related to naval studies. This year more than fifty cash prizes and scholarships, representing over \$10,000 in awards will be awarded. The Fair is totally privately funded by philanthropic organizations, local businesses, and individuals. See the Sponsors List on page 8.

For more information, visit us at CtSTEMfoundation.org. The Connecticut STEM Foundation, Inc. is an all-volunteer, IRS 501(c)(3) non-profit organization.

The Connecticut STEM Foundation, Inc. Mission

Our mission is to foster interest among all Connecticut high school students in science, technology, engineering, and math (STEM) by providing experiences for them to present their original research and interact with like-minded students and professionals.

We advocate for STEM and we seek to inspire and educate students, academics, parents and other members of our communities. In addition to sponsoring the Connecticut

STEM Fair each year, the Connecticut STEM Foundation has supported advanced teacher training, and held some extraordinary events for students to see the practical application of science via field trips and lectures.

Please visit us at our website: CTSTEMfoundation.org for more information.

Scholarship Program for Graduating Seniors and Summer Science Program

The Connecticut STEM Foundation, Inc. is pleased to announce a scholarship program open to all graduating seniors.

Seniors who have participated in this year's Connecticut STEM Fair are eligible to apply for financial support to help pay for their freshman year college expenses. **This year there will be (1) scholarship in the amount of \$500. Deadline for submission of completed college scholarship application is Monday, May 1, 2017 at 5:00 pm.**

Scholarships will be awarded to graduating seniors, majoring in one of the four science categories: Science, Environmental, Health Field or Medicine, and Physical or Engineering.

Students in grades 9, 10, and 11, who have participated in this year's Connecticut STEM Fair are eligible to apply for financial support towards a summer science program expenses. **This year there will be one (1) scholarship in the amount of \$500. Deadline for submission of completed summer scholarship application is June 1, 2016 at 5:00 pm.**

For more information about applying for these scholarships, go to our website: CTSTEMfoundation.org and click on the tab, Scholarships.

To make a donation to the scholarship fund, please send an email to info@CTSTEMfoundation.org.

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

Christine Leventhal
David Lewis
Guy Pratt

Greens Farms Academy

Mathieu Freeman

Greenwich High School

Andy Bramante

Joel Barlow High School

Katherine Nuzzo

Newtown High School

Tim DeJulio

Ridgefield High School

Ryan Gleason
Patrick Hughes
Michael Yagid

Sacred Heart Academy

Elizabeth Christophy

Staples High School

Karen Thompson

The Connecticut STEM Foundation, Inc.

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Directory of Student Participants

Student	School	Category	Project #
Ahmad, Yusuf.....	ARHS.....	Completed Project, Physical Science.....	57
Alindogan, Nicole.....	RHS.....	Research Proposal, Health and Medical.....	39
Anumolu, Mounisha.....	ARHS.....	Completed Project, Environmental.....	215
Arellano, Nicole.....	SHS.....	Completed Project, Health and Medical.....	114
Arevalo, Kellie.....	DHS.....	Research Proposal, Environmental.....	2
Bachman, Jeremy.....	ARHS.....	Research Proposal, Behavioral.....	38
Balaji, Suvasini.....	ARHS.....	Completed Project, Health and Medical.....	241
Ballas, Samantha.....	JBHS.....	Research Proposal, Health and Medical.....	153
Banks, Colin.....	DHS.....	Completed Project, Health and Medical.....	20
Barnet, Scott.....	GFA.....	Research Proposal, Health and Medical.....	80
Barnett, Sarah.....	SHS.....	Completed Project, Health and Medical.....	124
Barretta, Katie.....	ARHS.....	Research Proposal, Health and Medical.....	96
Barry, Talia.....	ARHS.....	Research Proposal, Physical Science.....	48
Beckford, Chelsea.....	CSH.....	Research Proposal, Health and Medical.....	37
Benedetti, Joseph.....	ARHS.....	Research Proposal, Environmental.....	244
Benz, Andrew.....	DHS.....	Completed Project, Physical Science.....	139
Beshoory, Jacqueline.....	CSH.....	Research Proposal, Health and Medical.....	246
Beshoory, Stephanie.....	CSH.....	Research Proposal, Environmental.....	132
Bevill, Corinne.....	DHS.....	Research Proposal, Health and Medical.....	113
Bhattarai, Nitya.....	ARHS.....	Completed Project, Health and Medical.....	54
Bi, Jimmy.....	ARHS.....	Completed Project, Physical Science.....	221
Black, Madeleine.....	CSH.....	Research Proposal, Environmental.....	214
Boczar, Adam.....	JBHS.....	Research Proposal, Environmental.....	134
Bonat, Alexandra.....	ARHS.....	Completed Project, Health and Medical.....	210
Borecki, Claire.....	DHS.....	Completed Project, Behavioral.....	105
Borecki, Elizabeth.....	DHS.....	Research Proposal, Health and Medical.....	187
Brey, Daniel.....	JBHS.....	Research Proposal, Environmental.....	123
Briody, Lucy.....	RHS.....	Completed Project, Environmental.....	181
Britto, Yohann.....	RHS.....	Research Proposal, Health and Medical.....	166
Brown, Onora.....	DHS.....	Completed Project, Environmental.....	13
Burd, Lauren.....	CSH.....	Research Proposal, Health and Medical.....	16
Burke, Quinnlan.....	ARHS.....	Completed Project, Health and Medical.....	207
Burns, Joshua.....	RHS.....	Research Proposal, Physical Science.....	167
Campanella, Escher.....	DHS.....	Completed Project, Physical Science.....	195
Carballo, Manuel.....	GHS.....	Completed Project, Environmental.....	150
Carlo, Mary.....	DHS.....	Research Proposal, Health and Medical.....	177
Carnes, Ashley.....	NHS.....	Research Proposal, Behavioral.....	176

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

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

RHS: Ridgefield High School, Ridgefield
SHA: Sacred Heart Academy, Hamden
SHS: Staples High School, Westport

Directory of Student Participation (continued)

Student	School	Category	Project #
Cerbin, Luca.....	JBHS.....	Research Proposal, Environmental	138
Chaudhry, Ariba.....	ARHS.....	Research Proposal, Behavioral.....	87
Chen, Alicia	ARHS.....	Completed Project, Health and Medical.....	205
Chow, Sophia.....	GHS.....	Completed Project, Health and Medical.....	171
Clark, Sammy.....	CSH.....	Research Proposal, Health and Medical	17
Clarkin, Maia	RHS.....	Research Proposal, Behavioral.....	168
Cohen, Rebecca.....	RHS.....	Research Proposal, Environmental	170
Colao, Annie	RHS.....	Research Proposal, Environmental	23
Corney, Elizabeth	DHS	Research Proposal, Health and Medical	196
Cortellesi, Sophia.....	DHS	Research Proposal, Health and Medical	108
Crafford, Leanna	RHS.....	Completed Project, Health and Medical.....	27
Criscuolo, Edward.....	ARHS.....	Completed Project, Environmental.....	66
Criscuolo, Emily	ARHS.....	Completed Project, Health and Medical.....	216
Cunningham, Megan	DHS	Research Proposal, Behavioral.....	10
Cunningham, Katherine.....	DHS	Completed Project, Environmental.....	110
D'Arche, Hannah	ARHS.....	Research Proposal, Behavioral.....	232
Davis, Adrianna	RHS.....	Research Proposal, Environmental	64
Day, Madison	CSH.....	Research Proposal, Environmental	81
DeBrino, Zachary	SHS.....	Research Proposal, Environmental	102
de Lange, Sarah.....	RHS.....	Research Proposal, Environmental	7
DeNunzio, Emily	DHS	Research Proposal, Health and Medical	26
Dey, Rhea	ARHS.....	Research Proposal, Behavioral.....	89
Dharani, Himay.....	ARHS.....	Completed Project, Physical Science	101
Dimm, Katelyn.....	RHS.....	Research Proposal, Environmental	19
Ding, Howard	ARHS.....	Completed Project, Environmental.....	240
Dixit, Agrani	ARHS.....	Completed Project, Health and Medical.....	67
Doman, Anna	RHS.....	Research Proposal, Health and Medical	9
Driscoll, Julia	RHS.....	Research Proposal, Health and Medical	44
Du, Rosie	ARHS.....	Completed Project, Physical Science	98
Du, Weixin	ARHS.....	Completed Project, Behavioral	225
Dubovik, Ulada.....	ARHS.....	Completed Project, Health and Medical.....	68
Dym, Caroline	CSH.....	Research Proposal, Health and Medical	16
Edwardson, Kaitlin	CSH.....	Research Proposal, Health and Medical	63
Erickson, Spencer	DHS	Research Proposal, Health and Medical	144
Estra, Dana	ARHS.....	Completed Project, Environmental.....	129
Feuerstein, Jacob.....	ARHS.....	Completed Project, Health and Medical.....	52
Filiato, Tristan.....	NHS	Research Proposal, Environmental	155
Findlan, Emily	DHS	Research Proposal, Environmental	202
Finn, Caroline.....	CSH.....	Research Proposal, Physical Science.....	83
Finnegan, Thomas	DHS	Research Proposal, Physical Science.....	143
Fischman, Allison	ARHS.....	Completed Project, Health and Medical.....	56
Friedman, Alexander	ARHS.....	Completed Project, Health and Medical.....	222
Gazaryan, Biatris.....	DHS	Research Proposal, Health and Medical	156
Gianukakis, Ariel	DHS	Completed Project, Environmental.....	42
Gilbride, Austin	ARHS.....	Research Proposal, Environmental	244

Directory of Student Participation (continued)

Student	School	Category	Project #
Gnidula, Martin	ARHS	Research Proposal, Environmental	237
Goll, John	DHS	Research Proposal, Environmental	190
Gordon, Tyler	RHS	Research Proposal, Environmental	154
Gorey, Catherine	DHS	Completed Project, Behavioral	198
Gowda, Jethin	ARHS	Completed Project, Physical Science	112
Gowda, Shiva	ARHS	Completed Project, Health and Medical	242
Granath, Will	DHS	Completed Project, Environmental	199
Grant, Arden	RHS	Research Proposal, Behavioral	4
Greene, Nicole	RHS	Completed Project, Physical Science	51
Greifenberger, Courtney	ARHS	Completed Project, Physical Science	98
Gross, Jacob	ARHS	Completed Project, Health and Medical	120
Grosso, Danielle	ARHS	Completed Project, Environmental	43
Grusky, Alexandra	CSH	Completed Project, Environmental	5
Gunawardana, Dileka	JBHS	Research Proposal, Health and Medical	119
Gurung, Nima	RHS	Research Proposal, Physical Science	178
Hager, Paul	DHS	Research Proposal, Health and Medical	183
Halabi, Carson	DHS	Research Proposal, Environmental	130
Hallisey, Olivia	GHS	Completed Project, Health and Medical	122
Handler, Katherine	ARHS	Completed Project, Environmental	74
Hayman, Elizabeth	JBHS	Research Proposal, Environmental	127
He, James	ARHS	Completed Project, Behavioral	201
Hennessy, Morgan	CSH	Research Proposal, Behavioral	25
Henry, Ciara	CSH	Research Proposal, Environmental	33
Herrmann, Alexandra	CSH	Research Proposal, Environmental	132
Hervey, Bettina	CSH	Research Proposal, Behavioral	45
Herzig, Julia	CSH	Research Proposal, Health and Medical	21
Hicks, Jack	RHS	Research Proposal, Physical Science	6
Holl, Ella	CSH	Research Proposal, Health and Medical	146
Hollander, Evan	ARHS	Research Proposal, Behavioral	95
Hopper, Juliana	SHS	Research Proposal, Environmental	104
Horn, Haley	CSH	Research Proposal, Health and Medical	246
Hu, Qingli	ARHS	Completed Project, Health and Medical	151
Jafri, Danya	DHS	Research Proposal, Health and Medical	189
Jain, Anisha	ARHS	Completed Project, Health and Medical	209
Jarad, Khaled	ARHS	Completed Project, Behavioral	217
Jarad, Haya	ARHS	Completed Project, Behavioral	218
Johnson, James	DHS	Research Proposal, Physical Science	28
Jones, Barbara	CSH	Research Proposal, Health and Medical	21
Jones, Olivia	RHS	Research Proposal, Environmental	158
Jordan, Stephanie	CSH	Research Proposal, Environmental	36
Juan, Charlotte	DHS	Research Proposal, Environmental	197
Katz, Jason	SHS	Research Proposal, Environmental	133
Khani, Nikzad	ARHS	Completed Project, Health and Medical	142
Khire, Priti	ARHS	Completed Project, Environmental	126
Kiefer, Rahul	JBHS	Research Proposal, Environmental	12

Directory of Student Participation (continued)

Student	School	Category	Project #
Kim, Mina	ARHS	Research Proposal, Environmental	233
King, Katharine	RHS	Research Proposal, Health and Medical	31
Klein-Wassink	JBHS	Research Proposal, Environmental	135
Knight, Hannah	DHS	Research Proposal, Health and Medical	200
Kosnik, Lily	DHS	Research Proposal, Environmental	79
Kovalenko-Baloup, Paolina	CSH	Research Proposal, Environmental	71
Kupcho, Lindsey	ARHS	Completed Project, Behavioral	212
Lam, Jonathan	JBHS	Completed Project, Environmental	128
Landler, Anna	RHS	Research Proposal, Environmental	8
Landry, David	JBHS	Research Proposal, Environmental	32
Lauter, Kailey	JBHS	Research Proposal, Environmental	141
Lebreck, Michael	ARHS	Research Proposal, Environmental	91
Ledbetter, Jenna	JBHS	Research Proposal, Environmental	147
Lee, Sean	ARHS	Research Proposal, Physical Science	84
Lee, Christina	ARHS	Completed Project, Behavioral	208
LeMay, William	NHS	Completed Project, Physical Science	1
Leyson, Abigail	CSH	Research Proposal, Behavioral	152
Li, Vince	ARHS	Research Proposal, Physical Science	73
Li, Cheyenne	DHS	Research Proposal, Health and Medical	107
Li, Connor	GHS	Completed Project, Physical Science	172
LLi, Catherine	RHS	Research Proposal, Health and Medical	179
Liu, Felix	ARHS	Completed Project, Physical Science	55
Liu, Jody	ARHS	Research Proposal, Behavioral	229
Livesay, Thomas	ARHS	Completed Project, Environmental	136
Lochtefeld, John	DHS	Research Proposal, Health and Medical	184
Lowe, Courtney	DHS	Completed Project, Environmental	193
Lu, Raymond	ARHS	Research Proposal, Behavioral	90
Lu, Tracy	ARHS	Research Proposal, Behavioral	92
Luo, Ningxin	ARHS	Research Proposal, Behavioral	82
Ma, Steven	GHS	Completed Project, Physical Science	188
MacKay, Madison	ARHS	Completed Project, Behavioral	58
Maerean, Nora	RHS	Research Proposal, Behavioral	180
Mahler, Samuel	ARHS	Completed Project, Health and Medical	3
Malhotra, Manvi	DHS	Research Proposal, Health and Medical	35
Margolin, Samantha	RHS	Research Proposal, Environmental	14
Marin, Ella	ARHS	Research Proposal, Behavioral	94
Maro, Elise	DHS	Research Proposal, Health and Medical	62
McCormack, Erin	ARHS	Completed Project, Physical Science	137
McCormack, Kelsey	ARHS	Completed Project, Physical Science	101
McGerald, Kasey	RHS	Research Proposal, Health and Medical	159
McQuilkin, Callie	RHS	Research Proposal, Environmental	161
Mehta, Tanmay	DHS	Research Proposal, Health and Medical	148
Menta, Ameya	ARHS	Research Proposal, Behavioral	231
Miller, Nicole	RHS	Research Proposal, Behavioral	160
Minichetti, Dante Grace	GHS	Completed Project, Health and Medical	163

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Student	School	Category	Project #
Molot, Henry	ARHS	Completed Project, Health and Medical	226
Mongillo, Leah	ARHS	Completed Project, Behavioral	206
Mongillo, Nicole	ARHS	Research Proposal, Behavioral	238
Moon, Jasmine	ARHS	Completed Project, Health and Medical	34
Moon, Jay	ARHS	Research Proposal, Behavioral	93
Morano, Gianna	CSH	Research Proposal, Behavioral	152
Morgan, Kayla	ARHS	Research Proposal, Environmental	235
Morr, Caleigh	DHS	Completed Project, Health and Medical	118
Murali, Aniruddha	SHS	Research Proposal, Environmental	102
Murphey, Bridget	CSH	Research Proposal, Environmental	81
Murphy, Eva	RHS	Completed Project, Health and Medical	29
Nadelmann, Julia	ARHS	Completed Project, Behavioral	245
O'Connor, Kelsey	NHS	Completed Project, Environmental	76
Palvinski, Alexandr	JBHS	Research Proposal, Environmental	135
Panageas, Krista	RHS	Research Proposal, Health and Medical	173
Paradis, Simone	NHS	Research Proposal, Behavioral	162
Park, Sebin	ARHS	Completed Project, Environmental	224
Pashankar, Neha	ARHS	Completed Project, Behavioral	75
Pashankar, Sana	ARHS	Completed Project, Health and Medical	203
Patel, Rohan	ARHS	Completed Project, Health and Medical	72
Paul, Akanksha	ARHS	Research Proposal, Health and Medical	234
Percarpio, Connor	DHS	Research Proposal, Environmental	103
Pfrommer, Daniel	DHS	Completed Project, Physical Science	99
Pfrommer, Samuel	DHS	Completed Project, Physical Science	125
Pickett, Madelyn	ARHS	Completed Project, Health and Medical	69
Piriz, Sofia	CSH	Research Proposal, Behavioral	30
Prato, Juliette	CSH	Research Proposal, Health and Medical	70
Pratt, Charles	RHS	Completed Project, Environmental	121
Price, Alex	RHS	Research Proposal, Environmental	40
Prinz, Natalie	ARHS	Research Proposal, Behavioral	86
Racanelli, Brielle	DHS	Research Proposal, Environmental	49
Raissi, Siavash	ARHS	Research Proposal, Behavioral	230
Rappaport, Hannah	ARHS	Completed Project, Behavioral	53
Rene, Nephthalie	CSH	Research Proposal, Behavioral	152
Richards, Taylor	DHS	Research Proposal, Health and Medical	191
Roitman, Adam	GHS	Completed Project, Health and Medical	18
Russell, William	DHS	Research Proposal, Physical Science	28
Samal, Arushi	DHS	Research Proposal, Health and Medical	116
Santoro, Kevin	RHS	Completed Project, Health and Medical	24
Saxe, Sarah	ARHS	Completed Project, Behavioral	220
Schaaf, Summer	ARHS	Completed Project, Environmental	211
Scheck, Alexander	RHS	Completed Project, Physical Science	149
Selmon, Nevia	ARHS	Completed Project, Environmental	100
Shaw, Emily	JBHS	Research Proposal, Environmental	127
Silliman, Jacob	ARHS	Completed Project, Physical Science	60

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Student	School	Category	Project #
Silver, Natalie	RHS	Research Proposal, Health and Medical	15
Singer-Freeman, Ari	DHS	Completed Project, Environmental	182
Slanski, Abigail	ARHS	Research Proposal, Behavioral	46
Sonnenberg, Noah	GFA	Completed Project, Environmental	145
Spiegel, Julia	CSH	Research Proposal, Health and Medical	17
Starke, Angelique	CSH	Research Proposal, Health and Medical	37
Stefani, Agustina	GHS	Completed Project, Environmental	164
Stimpson, Johnathan	DHS	Completed Project, Behavioral	186
Sudhir, Neha	ARHS	Completed Project, Environmental	211
Sugarmann, David	ARHS	Research Proposal, Physical Science	88
Sugarmann, Joseph	ARHS	Completed Project, Health and Medical	3
Sundaram, Shobhita	GHS	Completed Project, Health and Medical	165
Swift, Alexandra	DHS	Research Proposal, Behavioral	50
Tajmajer, Jack	ARHS	Research Proposal, Behavioral	97
Teltser, Jory	SHS	Research Proposal, Environmental	117
Tenerowicz, Keri	ARHS	Completed Project, Physical Science	59
Thombre, Aman	ARHS	Research Proposal, Physical Science	204
Todeasa, Julia	ARHS	Completed Project, Environmental	239
Tom, Anthony	ARHS	Research Proposal, Health and Medical	228
Torreso, Fallon	NHS	Research Proposal, Health and Medical	77
Van de Graaf, Justin	DHS	Research Proposal, Health and Medical	106
Verdejo, Joshua	RHS	Completed Project, Physical Science	22
Vernal, Chris	DHS	Research Proposal, Health and Medical	78
Vrooman, Kelsey	DHS	Research Proposal, Health and Medical	185
Wang, Sophia	ARHS	Research Proposal, Environmental	85
Wang, Sienna	ARHS	Research Proposal, Behavioral	236
White, Tim	NHS	Research Proposal, Health and Medical	111
Wilson, Will	DHS	Research Proposal, Health and Medical	192
Wolters, Quin	DHS	Research Proposal, Health and Medical	109
Yanagisawa, Kevin	ARHS	Completed Project, Environmental	243
Yin, William	GHS	Completed Project, Health and Medical	174
Yoo, Olivia	DHS	Research Proposal, Health and Medical	41
You, Victor	ARHS	Research Proposal, Physical Science	47
Yuan, Kate	ARHS	Completed Project, Physical Science	61
Yuen, Jack	DHS	Research Proposal, Physical Science	115
Zafar, Baasim	ARHS	Research Proposal, Physical Science	227
Zaminski, Devyn	GHS	Completed Project, Environmental	157
Zhang, Lillian	ARHS	Completed Project, Health and Medical	223
Zhang, Joshua	SHS	Research Proposal, Environmental	131
Zhao, Kevin	ARHS	Completed Project, Health and Medical	65
Zhou, Yuqi	ARHS	Completed Project, Behavioral	219

William LeMay

Project #1

Completed Project, Engineering, Physical Science

The Synthesis of Silica X-Aerogel through the sub critical process

The purpose of this experiment is to create a new variation of Silica X-Aerogels that have improved strength without significant increases to the density by altering how the aerogels are washed in the subcritical process. My motivation for creating this project is my desire to create aerogels with more practical applications for use in equipment sent up to space. Lower densities and higher strengths will result in lower overall costs. Tartaric Acid is combined with Sodium Silicate while being constantly stirred, forming a gel. After three hours of aging at 50 degrees Celsius, the gel is washed four times with water to clean it. Then, the gel must be washed with a solution of Methanol and Hexane. Finally, the gel is dried at 50 degrees for one hour, then 200 for another. The expected result of this experiment is that an ideal ratio of hexane to methanol for silica X-aerogel production will be discovered, and a successful Silica X-aerogel will have been produced that has low weight and also exceptional strength. From previous experiments I have also discovered that Silica X-aerogels are not able to be synthesized when ethanol is used in the initial steps. The implications of this research are vast for the future of organizations like NASA and Space X. Silica X-Aerogels that have high strength with low densities would allow for far less mass needed to do the same task. Since Aerogels can already be used for insulation, increasing their strength so they can function as structural support will allow for much less material sent into space, saving countless dollars.

Newtown High School
Tim DeJulio, Teacher

Kellie Arevalo

Project #2

Research Proposal, Science, Environmental

Regulating Zebra Mussel Population with Zequanox

Invasive species have been affecting terrestrial and aquatic ecosystems all over the world by disrupting the food chain and creating competition between native species. They also pose a threat to boaters as the mussels get caught in the engine, and compete with native fish species for zooplankton prey. In the 1980s, it is believed the zebra mussel was introduced to the Great Lakes, via a cargo ship travelling from the Caspian Sea in Europe. The introduction of zebra mussels has made significant impacts on the Great Lakes and other bodies of water in the midwest by increasing phytoplankton abundance, decreasing turbidity, and increasing the amount of dissolved nutrients. For invasive species such as the zebra mussel, there are currently no effective controls over the spread and growth of its population. This experiment will use Zequanox, a composition of dead cells derived from naturally occurring microbe soil bacteria *Pseudomonas fluorescens*. Zequanox is known for its direct effect, easy treatment, and application flexibility when compared to other chlorine and chemical pesticide options. As the Zequanox is added to the water, zebra mussels consume the biopesticide and their digestive systems deteriorate, causing death. Although similar research is being conducted, this experiment will evaluate the full effect of Zequanox on zebra mussel population and its full-term effect on the invasive species.

Darien High School
David Lewis, Teacher

Samuel Mahler
Joseph Sugarmann

Project #3

Completed Project, Science, Health and Medical

The Effect of Foot Arch Height on the Area of Maximum Force the Foot Exerts While Running

Most runners run with a rear-foot strike. In this study, we looked for a correlation between foot arch height and foot strike while running both at a relaxing pace and an increased pace. The independent variable was the height of one's foot arch, while the dependent variable was the foot strike location. A variety of male distance runners participated in this study from a local High School Cross Country team. To compensate for most runners running with a rear to mid foot strike, foot strike was measured as the distance (cm) from the heel of the foot to the point of highest average and maximum pressure the foot exerts while running. There was no control group. Each participant's foot arch was measured using an Arch Height Index Measurement System. Dominant foot and shoe type were also recorded. Each participant ran on a treadmill first at a predetermined slower pace for 5 minutes, then for 3 minutes at a predetermined increased pace. During the final minute of each section, the treadmill recorded the force exerted by each foot as it landed on the surface. Results project a higher foot arch to cause the most force to be exerted closer to the toes. They project a smaller arch to cause the most force to be exerted closer to the heel. Data was statistically analyzed to locate any possible trends. Results could help prevent running-related injuries and help athletes not accustomed to running choose their ideal foot strike. It could also be used to help experienced runners decide what type of foot strike they should attempt to learn, as foot strike can be forced.

Amity Regional High School
Deborah Day, Teacher

Arden Grant

Project #4

Research Proposal, Science, Behavioral

How estrogen in mice can correlate to intelligence and motor skills

Pervious data and experiments have shown that female mice tend to have better motor skills and higher intelligences than male mice, but it is unknown why exactly that it. This experiment will be experimenting on the problem statement; if a mouse has a high level of estrogen in their body, they will have a much higher IQ or intelligence level than those with low levels of estrogen and will also have more efficient motor skills. After selecting a group of mice, each mouse will be tested for the levels of estrogen in their bodies. After obtaining that data, the mice will then be tested for IQ levels. Then the mouse will be put through the "rotarod test", a test where the mouse is placed on a horizontal rod that rotates and has to walk forward, stay upright, and not fall off. The mice's motor skills are measured by how long the mouse is able to stay on the rod with out falling off. After the data is collected, it will be compared to see if there is a correlation between estrogen and high levels of IQ and motor skills. It is predicted that there will be a correlation between estrogen, intelligence and motor skills in mice. The mice with higher levels will have higher IQs and better motor skills than those with low estrogen levels. It can be implicated that there will be some data that won't be accurate or usable due to outside forces that may interfere with the mice and experiment. There may also be other forces that contribute to IQ and motor skills that will not be able to be measured in this experiment.

Ridgefield High School
Patrick Hughes, Teacher

Alexandra Grusky

Project #5

Completed Project, Science, Environmental

A Temporal and Spatial Distribution Assessment of *Centropristis striata* for the Appraisal of Oyster Aquaculture Cages as Suitable Artificial Habitats for Temperate Fish

Distribution and abundance of juvenile *Centropristis striata* (Black Sea Bass) on and around a naturally occurring rocky reef, off-bottom oyster aquaculture cage, and a shell-bottom environment, were recorded over a three-month period. As Black Sea Bass typically prefer an environment with 3-dimensional (3D) structure that allows for predator protection, it was hypothesized that the natural rocky reef and off-bottom aquaculture cages would be high and comparable in average fish abundance. The on-bottom shellfish farm has low 3D complexity, so was hypothesized to have the least abundance of Black Sea Bass. The juvenile Black Sea Bass were sampled using baited traps deployed at 6 sites (2 replicate sites per each habitat type). Average abundance was calculated per habitat using the number of fish collected per capture day at each site. Over the study period, a total of 734 Black Sea Bass were recorded. Data showed that the average abundance was higher in the shell-bottom traditional shellfish farm environment, rather than the natural rocky reef area or aquaculture cages as predicted. Surprisingly, the abundance of fish was lowest in the rocky reef environment, although the rocky reef and aquaculture cage habitats were closer in average abundance than they were to the shell-bottom habitat. Future work would include using fish length data to see if the high concentration in the shell-bottom environment is comprised of older juveniles on the cusp of no longer needing the protection of the 3-dimensional environment.

Convent of the Sacred Heart
Mary Musolino, Teacher

Jack Hicks

Project #6

Research Proposal, Science, Physical Science

Graphene Composites as Ballistic Resistant Materials

Graphene has been hailed as having great potential as a ballistic resistant material, but it does have certain flaws regarding structural integrity after sustaining an impact. A graphene composite needs to be created in order for the material to sustain multiple impacts. This experiment intends to solve that problem by testing several graphene composites and comparing them to each other. The composites will also be compared to standard graphene. In order to compare the structural integrity of the graphene composites to regular graphene, the experiment will use a LIPIT (laser induced projectile impact test) to determine the energy required to penetrate the materials. The quantitative results of this will be compared, along with pictures of the projectile impact, to determine if the composites are superior to pure graphene in terms of multiple projectile impact. The expected findings and results of this experiment would show that the graphene-composites have a similar or superior required penetration energy when compared to regular graphene. The graphene-composites would also have a much smaller penetration hole, demonstrating a higher material strength post-impact. The implications of this experiment are that a viable composite which can sustain multiple projectile impacts could be invaluable in developing a new generation of ballistic resistant materials. A graphene-composite based body armor could replace modern projectile-resistant equipment, and potentially save lives.

Ridgefield High School
Patrick Hughes, Teacher

Sarah de Lange

Project #7

Research Proposal, Science, Environmental

Environmental Efficiency of Water Usage on Tomato Plants

Water usage in farms is a large problem with the growing population. Current systems used to irrigate land are not sustainable. Over 60% of the freshwater used by humans is for agricultural purposes. This amount needs to be minimized. This experiment will determine the minimum amount of water needed to grow a healthy tomato plant. Four tomato plants will be used. Each will be placed in a container of equal size with the same type of soil. Different methods of watering the plants will be assessed. Examples of this is watering based on time, soil moisture, and precipitation. It is expected that the tomato plant watered based on soil moisture will be the healthiest plant. The tomato plant watered by precipitation will be the most water efficient. This research will help to determine how much water can be used for agriculture without using all of the resource while being able to support the growing population.

Ridgefield High School
Patrick Hughes, Teacher

Anna Landler

Project #8

Research Proposal, Science, Environmental

Correlation between arbuscular mycorrhizal fungi abundance and fungal exudates

In the face of growing population and food demand, I am interested in looking into the promotion of sustainable organic agriculture, or ecological intensification. I hope to investigate how to utilize the already-present microbial communities, specifically arbuscular mycorrhizal fungi (AMF), in order to maximize plant yield. One of the major barriers to management of these communities is simple monitoring of the AMF. I propose that, since fungal exudates are released by spores before the AMF's colonization of the roots, a correlation between these Myc factors and AMF abundance might be found. Using a specific pair of AMF and a corresponding host plant, such as *Glomus irregulare* and pea plants, I would conduct controlled pot experiments. The results of my research would involve measurements abundance of both AMF, likely measured using the microscopic grid method, and the fungal exudates, or myc factors using chemical analysis. A statistical analysis of the data would reveal either a correlation between AMF abundance and presence of specific fungal exudates or lack thereof. My findings should join the growing body of research involving maximization of native AMF for crop benefit. If scientists can correlate the release of specific fungal exudates with AMF abundance, this would improve monitoring of AMF in crop fields. This has the potential to subsequently improve management of the microbial community, therefore potentially increasing crops yields without the detrimental environmental effects of other land management practices.

Ridgefield High School
Patrick Hughes, Teacher

Anna Doman**Project #9**

Research Proposal, Science, Health and Medical

The effect of Iodine restriction on the production of thyroid hormones

Hashimoto's thyroiditis is a thyroid autoimmune disorder that affects 14 million individuals in the USA alone. Many factors are attributed to the development of Hashimoto's, with iodine intake being very prevalent. Despite this, iodine plays a crucial role in proper thyroid function and may help to alleviate some symptoms of hypothyroidism. The goal of this project is to observe the effects of iodine restriction on production of thyroid hormones. For this project, four different levels of iodine intake will be tested on mice in both the euthyroid and hypothyroid state. The mice will be given either a high ($>150\mu\text{g}$), average dose ($=150\mu\text{g}$), low dose ($<150\mu\text{g}$), or no dose of potassium iodide. For a period of two weeks, these supplements will be given with thyroid hormone levels tested. TSH, fT4 and TPOAb/TgAb levels will be measured periodically. The projected results are that the varied amounts of iodine will alter the hormone production in the mice. For the hypothyroid mice, low iodine dosages should increase the amount of fT4, and decrease the amount of TSH as well as TPOAb and TgAb. The average intake should yield consistent levels of hormone and autoantibody production. The high dosage should result in a decrease in fT4, and increase autoantibodies and TSH. Iodine restriction could potentially become a major treatment for Hashimoto's thyroiditis or other thyroid specific autoimmune disorders. The traditional treatment for Hashimoto's is levothyroxine monotherapy, which is a synthetic T4 medication. This treatment, despite its popularity, is unresponsive in a significant amount of individuals. Iodine restriction therapy could be used to alleviate the symptoms of those unresponsive to common therapies and treatments.

Ridgefield High School
Ryan Gleason, Teacher

Megan Cunningham**Project #10**

Research Proposal, Science, Behavioral

The Effect of Feeding Enrichment on the Behavior of Captive Wolves

With the increasing popularity of zoos across the world, it is important that zoos work to promote the most natural behaviors in their endangered animals so as to better prepare them for reintroduction to the wild. This study will measure the effect of environmental feeding enrichment on the natural behaviors of gray wolves. This study will measure the effect of environmental feeding enrichment on the natural behaviors of gray wolves. The experiment will study 30 different subjects of the *Canis lupus* species over the span of 27 feeding days. The study interval will be divided into 3 time periods - pre-enrichment, enrichment, and post-enrichment days. During pre- and post-enrichment days the subjects will be fed their regular diet of 12 lbs of meat from a large ungulate. During enrichment days 2 lbs of de-skinned chicken will be substituted for the same amount of ungulate meat, hung from a tree found in the enclosure. Behavior will be measured in 10 minute intervals throughout the three hours of feeding time per day and all observed actions will be placed into one of 3 categories: stereotypic, resting, or explorative. Upon use of a chi-square test to analyze the data, the experiment is predicted to result in a positive significant change in the frequency of explorative behavior during the enrichment period, though no significant change is expected in stereotypic behavior during the 3 time periods. In light of the results, better methods of feeding enrichment could be suggested for many captive zoo animals whose natural behaviors are very important to preserve. To look even further, such an experiment could be modified to search for similar results in a non-mammalian species.

Darien High School
Guy Pratt, Teacher

Rahul Kiefer

Project #12

Research Proposal, Science, Environmental

The Study of the Filtration Effects of the Flowing of Water Contaminated with Escherichia coli K-12 Through the Xylem of Ficus Aurea

In India, the water in the Ganges River is not potable due to bacterial contaminants. I want to devise a method for locals to filter their own water, with a filter made out of materials that are easy to collect, inexpensive, and does not take significant expertise to use. I researched that plant xylem can be used to filter out pathogens in water, and a very common plant near the Ganges River is the banyan tree. I found a plant in the same species as the banyan tree in the US that I could get to experiment on. I will conduct experiments to find out if the xylem of *Ficus aureus* will filter out nearly all *E. coli* K-12 in a given sample. I will excise a branch of a *Ficus aureus* plant for use in experimentation. To construct the filter I will peel the bark off the branch and mount it at the end of a tube and seal with epoxy. I will use distilled water and dyed *E. coli* K-12 to conduct my filtration experiments; the solution will be fed through the top of the filter (the pvc tube), and the filtrate will be collected in glass vials. [Research proposal] The implications of this study will show that *Ficus benghalensis* could be used to filter out contaminated drinking water in villages in India, and that it can be possible for locals to create a filter themselves.

Joel Barlow High School
Katherine Nuzzo, Teacher

Onora Brown

Project #13

Completed Project, Science, Environmental

A Survey of Coral Disease and Bleaching on *Acropora cervicornis* and *Acropora palmata* in the British Virgin Islands

How does the state of health of both *Acropora palmata* and *Acropora cervicornis* compare to the state of health of ten other abundant coral species in the British Virgin Islands? The purpose of this experiment was to discover which diseases *Acropora palmata* and *Acropora cervicornis* are contracting. A roving survey style was conducted underwater. A group of two students swam alongside a dive leader. The group then followed the dive leader throughout each site. When either *Acropora cervicornis* or *Acropora palmata* was found, a tally was taken on an underwater slate. There were tick marks made for healthy corals. If the coral was diseased, abbreviations such as WB for white band were used. Representative photos of the diseased corals were also taken. While *Acropora cervicornis* was affected by bleaching, *Acropora palmata* was affected by both bleaching and white band disease. Both the diseased and healthy corals had low populations and high disease rates. Coral disease does not just harm the environment, but it also harms coastlines, the food chain, people's livelihoods, and local economies. Coral reefs shape coastlines. They serve as a natural seawall against erosion, and storms in low lying coastal areas. If corals die, many fish also lose shelter and a valuable food source. If fish do not have shelter, then they are vulnerable to predators. This destroys local fishing economies. This is because with increased predation, comes decreased fish populations and therefore nothing for fishermen to catch. Economies that rely on reefs for tourist attractions also lose money.

Darien High School
Christine Leventhal, Teacher

Samantha Margolin

Project #14

Research Proposal, Engineering, Environmental

Solar Cell Efficacy

In today's modern society the search for alternate energy sources other than coal is increasing, due the rising global temperature from using fossil fuels as a main source of energy. My goal is to create a solar cell using common materials to determine which will be most cost efficient and effective. Using methods from previous studies I will be testing various designs of solar cells in outdoor experiments in order to determine which is most cost effective and efficient. Testing different cell design methods such as dye coating, roll to roll printing, and perovskite solar cells, I will see which is most durable, efficient and cost effective. Through various outdoor tests I will put each of the cells through various trials in order to determine which will pass the tests with the most success. Through this experiment I hope to find which of the currently existing designs will prove most efficient and reasonable for use in today's modern world. The cells that are made with more protective outer shells will most likely be more durable than the hand made lab cells. However, I hope to find the efficacy rate of the cells in both the lab and the production made cells to see out of the two which will prove more effective in an outdoor setting. The amount of energy used is increasing rapidly, yet with the increase of burning fossil fuel has led to an increase in global warming. Solar technology is the way to help reduce this and through the creation of inexpensive, yet effective solar cells will become more common. Through this experiment I hope to determine which out of the many pre-existing techniques and designs of solar cells will prove to be most effective and cost efficient in an outdoor setting.

Ridgefield High School
Ryan Gleason, Teacher

Natalie Silver

Project #15

Research Proposal, Science, Health and Medical

The Impact of Sodium Chloride on the Effectiveness of Beta-Interferon 1A to Treat Multiple Sclerosis

2.3 million people worldwide have multiple sclerosis (MS). There is no cure or diagnostic test. What if the cause for multiple sclerosis in our environment? New research suggests that Sodium Chloride (NaCl) influences the worsening of autoimmune diseases like MS in cell cultures and in mice. I want to research the impact of sodium chloride on the effectiveness of the MS therapy beta-interferon 1A to reduce inflammation. I will stimulate the CD4+ T Cells to differentiate them into Th17 and Th1 cells and measure cytokines using flow cytometry. Then, I will culture the cells in high, low, and no salt cultures and measure the cytokine levels. Finally, I will culture the cells in beta-interferon 1A and use measure cytokine levels. The expression of inflammatory cytokines, which is measured using flow cytometry, represents inflammation in an MS patient. I predict that beta-interferon 1A will be least effective in reducing the proinflammatory cytokine levels in the high-salt Th17 cells. In addition, I predict that the no-salt and beta-interferon-1A-treated Treg cells will have the lowest levels of proinflammatory cytokines. Overall, I think that NaCl will reduce the effectiveness of beta-interferon 1A to treat multiple sclerosis. Research relating environmental factors to multiple sclerosis looks to new variables in disease pathogenesis. My research combines two groups of research, the environment and treatments, to look forward to improving the lives of patients, especially because diet is an environmental factor a person can control (as opposed to sunlight). Hopefully, MS patients will be able to modify their diet and treatment plans to work together in the future.

Ridgefield High School
Ryan Gleason, Teacher

**Caroline Dym
Lauren Burd**

Project #16

Research Proposal, Science, Health and Medical

**Evaluating the Bacteria Found in
Indoor Play Areas Vs. Public Restrooms**

The purpose of this experiment is to determine whether indoor play areas are more hazardous in terms of the bacteria present when compared to public restrooms. It is hypothesized that indoor play areas will contain more harmful bacteria than a public restroom. We will collect samples at indoor playgrounds and public bathrooms using Eswabs. Then, using the method of DNA barcoding and primers specific for bacteria, we will be able to isolate, amplify, and sequence the prevalent bacteria in each sample. We will compare the bacteria found in these locations, and conclude whether indoor playgrounds or bathrooms are more hazardous based on the bacteria present. It is expected that biosafety level 2 bacteria such as *Pseudomonas aeruginosa* and *Staphylococcus aureus* will be found in the play areas, whereas, biosafety level 1 bacteria such as *Bacillus cereus* and *Escherichia coli* will be found in the public restrooms. This experiment is important to help parents and guardians recognize the potential dangers their children could be exposed to in indoor playgrounds.

**Convent of the Sacred Heart
Mary Musolino, Teacher**

**Sammy Clark
Julia Spiegel**

Project #17

Research Proposal, Science, Health and Medical

**Is “Organic” Worth the Hype?
Bacterial Prevalence on Produce in
Farmers Markets versus Grocery Stores**

The purpose of this investigation is to determine the presence of *E. coli*, *Salmonella*, and the most prevalent bacteria on iceberg lettuce and tomatoes in farmers markets versus supermarkets using DNA barcoding, coliform testing, and *Salmonella* testing. It is hypothesized that the produce from the farmers markets will have a greater presence of potentially harmful bacteria as a result of less sterilization and avoidance of chemicals or pesticides. It is expected that finding these bacteria will occur twice as often in farmers markets' produce over grocery stores'. These results are significant because it is a common belief that the produce from farmers markets are healthier; however, in reality, it has been discovered that the farmers markets' produce have a higher prevalence of harmful bacteria. Studies such as these, however, are limited. These results are important because farmers markets generally have steeper prices for their produce due to their “freshness,” but they fail to acknowledge the potential greater risk of diseases from *E. coli*, *Salmonella*, and other bacteria.

**Convent of the Sacred Heart
Mary Musolino, Teacher**

Adam Roitman

Project #18

Completed Project, Science, Health and Medical

Novel Active Immunization Approach for Preventing Substance Addiction via High Density Trypanosoma brucei Variant Surface Glycoprotein Arrays

Each day, over 3,200 US teens smoke their first cigarette. Furthermore, drug overdose (many of which are due to opioids) is the leading cause of accidental death. Addiction not only poses grave health issues, but also major burdens on global economies. The progression of the disease of addiction is due to persistent behavioral and neurobiological changes, which, as a result of the complexity of the biological changes, make treatment difficult. This novel approach co-opts the surface coat (made up of ~11 million Variant Surface Glycoprotein (VSG) structures) of the African trypanosome *Trypanosoma brucei*, and uses it as a platform, via Sortase, a bacterially derived class of enzymes, to “display” foreign molecules (such as FAM-G fluorophore) and generate high affinity/high avidity antibodies through active immunization. Antibodies were detected in mouse sera using a sandwich ELISA approach. The assay revealed the presence of anti-FAMG antibodies from both sortagged trypanosome injected mice at both the 1:20 and the 1:100 dilutions. In contrast, both control samples (samples from animals immunized with non-sortagged trypanosomes) were at background values, remaining roughly the same between dilutions. Visual confirmation of the ELISA plate further confirms the presence of the antisera. Through this novel method of generating antibodies through the presentation of small molecules on the VSG protein array of *T. brucei*, I have shown that this method can indeed elicit a more effective and robust immune response within 8 days of injection (plus boost injection at 3 days). This approach can therefore be generalized to any small molecule, including those that are drugs of abuse and addiction.

Greenwich High School
Andrew Bramante, Teacher

Katelyn Dimm

Project #19

Research Proposal, Science, Environmental

Methylmercury in Sharks

Every year over one hundred million sharks are killed to fuel the consumer demand for shark meat and fins. This extent of overfishing has not only become a concern for various ecosystems, but physicians are growing increasingly concerned about the amount of methylmercury present in the sharks people are consuming, as the organic neurotoxin can have a wide range of horrendous health effects on humans. For my experiment I collected a large number of studies and drew correlations between various factors and methylmercury concentrations based on the findings. Thereby helping to create a better understanding of the way methylmercury accumulates in sharks. I found there were strong correlations between warmer water temperatures and growth rates with increased methylmercury concentrations. However, contradictory to previous beliefs there were no correlations between methylmercury and the size of the shark. For future experiments this data can be used to estimate the amount of methylmercury that should be. These conclusions, for future experiments can be used to help estimate the amount of methylmercury present in the sharks tested, and as methylmercury concentrations continue to rise across the globe, they can be used as a marker to watch a change in concentrations over time.

Ridgefield High School
Ryan Gleason, Teacher

Colin Banks

Project #20

Individual Project, Engineering, Health and Medical

Cloning of the IRES Gene for Targeted Viral Gene Therapy

Gene therapy is the transplantation of a desired gene into a cell or cells in order to add, replace, or delete missing, defective, or harmful genes for the purpose of manipulating genetic disorders. One pathway for implementing gene therapy is using a virus, specifically an adeno-associated virus (AAV), which is a subset of the parvoviridae (a family containing 56 species), in order to deliver genetic material directly to cells. The goal of this experiment is to produce genetic material for the virus. A major aspect of a successful application is having the correct genetic material at a reasonably effective cost to put into the virus through its pores. For the experiment, bacterial transformations were used to clone the IRES (internal ribosomal entry site) gene, a RNA element that allows for translation initiation. This cloning was done using EMCV (Encephalomyocarditis virus) IRES and Poliovirus IRES in the context of HIPK3 (homeodomain-interacting protein kinase 3), ZKSCAN1 (regulator of Kruppel-associated box subfamily of the zinc finger proteins), and circGFP (circular green fluorescent protein) constructs. This therapy is focused on developing techniques that adjust the genetic material inserted into the AAV capsid (containment vesicle). The GFP indicator was used to test transformation rates. The results showed successful cloning of the IRES gene in the backgrounds with cells containing GFP. Overall, transduction can be applicable to any disease that has a genetic component. The final goal of this therapy is to have the highest transduction rate or the highest rate of successful delivery of genes into the target chromosome(s) in the nuclei. The specific disease can then be affected through cell replication or the synthesis of proteins.

Darien High School
David Lewis, Teacher

Julia Herzig Barbara Jones

Project #21

Completed Project, Science, Health and Medical

The Effects of Choline on Learning, Memory, and Movement in *C. elegans*

Choline is a macronutrient that is present in the form of phosphatidylcholine, a compound that makes up the structural component of fat. Choline has been found to be important in liver function, nerve function, and muscle movement. The purpose of this experiment is to test if choline has an effect on the learning, memory, and movement in *C. elegans* in association with anxiety. The stress hormone cortisol is released in large amounts during times of high stress or anxiety and can lead to memory loss and learning impairments. It is hypothesized that *C. elegans* that have been exposed to choline will experience improvements in learning, memory, and movement when compared to those exposed to the control buffer. *C. elegans* will be grown and movements will be compared in both the choline and control buffer plates. Standard memory and learning tests for *C. elegans* will also be conducted for both choline and the control buffer. Results will be recorded. Survival will also be noted and compared for both the experimental and control worms. Preliminary results have been obtained and support the hypothesis since improvements in movement and learning have been demonstrated in the worms exposed to choline. More testing is needed, however, and will be conducted in the future. This experiment provides a first look at the effects of choline on the behavior of *C. elegans*. Improvements in all categories can implicate the use of choline as a natural approach to reducing symptoms of anxiety.

Convent of the Sacred Heart
Mary Musolino, Teacher

Joshua Verdejo

Project #22

Completed Project, Engineering, Physical Science

Integration of Brain Computer Interface as a Robotic Swarm Control System

Robotic swarms are being developed to exhibit cooperative behaviors, working together to achieve a common goal. Brain Computer Interface (BCI) works to allow the user to control an electronic device with their mind. This experiment looked to optimize the connection between the devices with a program that builds in a learning curve for users. The experiment worked to further the relationship between brain computer interface systems and robotic swarms. The Emotiv EPOC (a type of BCI) was used to control a robotic swarm comprised of Scribbler S2 robots. Distinct trials were run with time for completion and distance traveled without crashing being evaluated. Efficiency will be measured by having subjects complete tasks as quickly as possible without crashing. Three groups of trials were run: one control group with keyboard, one utilizing the program with BCI, and once BCI only. The control group comprised of simply keyboard input was the most efficient, however, the brain computer interface with the program was able to perform more efficiently than the one without the program by a significant margin. Without the program, the swarm was not able to complete the course once, while with the program, the robots were able to complete the course multiple times, with an 85% accuracy between the trials. This study will help give researchers in the blossoming fields of BCI and swarm robotics information when developing control techniques for swarms of robots. BCI and Robotic swarms have tremendous potential (construction using a mental mode, many robots, microrobotic swarms with the potential to perform internal surgery, etc.). This research brings technology closer to this potential by working to synergize the two systems.

Ridgefield High School
Ryan Gleason, Teacher

Annie Colao

Project #23

Research Proposal, Science, Environmental

Testing Various Shading Materials on Imitation Leatherback Sea Turtle Nests

Leatherback Sea Turtles, *Dermochelys coriacea*, are critically endangered in the Eastern Pacific. Only six percent of hatchlings survive their first year. Increasing sand temperatures decrease that number because temperatures above 29 degrees Celsius lead to lower hatching success rate. Those that do hatch are predominantly female, which attributes to the lower genetic diversity and population size, leading to extinction in coming decades. This is bad because leatherbacks balance jellyfish populations. Four holes 75cm deep in sand will be dug. Thermocouples will be put inside. The plots will be filled. Stakes will be stuck in the sand, and one of four materials will be wrapped around and stapled in place. Temperatures will be recorded every two hours. A constant amount of water will be poured onto the plots, then sand will be dug to see how far down the water went. Materials that will be most effective are agricultural netting, Sunblocker Premium Bulk Polyethene Knitted Shade 30%, and palm fronds. Netting is used in agricultural and keeps crops shaded and moist. Palm fronds are used as roofs in the Pacific to cool and shade. If woven with spaces between fronds, sufficient water will flow through. These two should decrease temperatures by two degrees Celsius from the control. Current natural nests are too hot and dry, making healthy and balanced incubation impossible. The material that proves effective in decreasing sand temperature while being permeable, can be implemented in sea turtle hatcheries. Covers over nests in hatcheries will increase number of male hatchlings as well as overall success rate, which will benefit their population by increasing number of turtles released into the wild which could prevent their extinction.

Ridgefield High School
Ryan Gleason, Teacher

Kevin Santoro

Project #24

Completed Project, Science, Health and Medical

The Effect of Insulin Growth Factor-I on Folliculogenesis in vitro

Current cancer treatments such as chemotherapy and radiation are toxic to both cancerous and healthy cells, including the ovaries. This research project aims to provide alternative to cryopreservation through an in vitro culture system and to also test the effects of insulin growth factor-I on follicle growth, which is the beginnings of the fertility testing application of this growth system. Follicles from 16 day old mice were removed, and secondary staged follicles were individually isolated from each ovary. 16 follicles were placed in each of the 9 different 96 well-plate culture dishes. Two plates were designated either control, 1ng/mL of IGF-I, or 10ng/mL of IGF-I which was diluted in normal growth media. Images were taken every 2 days over an 8 day period. 1ng/mL of IGF-I yielded the largest and most structurally sound follicles compared to both the 10ng/mL and the control groups. 1ng/mL was concluded to be the optimal concentration of IGF-I to properly grow follicles and maintain the follicle geometry by keeping the membranes intact. 10ng/mL did increase the size of the follicles, however, follicle morphology revealed the inability to mature these follicles, along with the control group. This research helped contribute to the protocol for providing an alternative to cryopreservation. IGF-I is a necessary growth factor in the process of folliculogenesis. The higher levels of insulin, 10ng/mL, are the predicted lower IGF levels for obese women and the control would resemble a women with diabetes. Both these conditions would not provide healthy fully grown follicles that would be able to ovulate.

Ridgefield High School
Ryan Gleason, Teacher

Morgan Hennessy

Project #25

Research Proposal, Science, Behavioral

Studying the Impact of Grit on the Success of Team Sports

Grit is the amount of passion and perseverance an individual has aimed towards a long-term goal. Grit can be measured by taking a grit scale test; a test developed by researcher Angela Duckworth. The research of Duckworth and her colleagues pertain to the role that grit plays in achieving success. According to Duckworth, accomplishments may not solely be based on ability level, but rather on the combination of ability and personality traits - such as grit. In the grit scale test, individuals answer questions based on their personal experiences and thoughts, and upon completion, a grit score is given on a scale of 0 to 5.0. This study proposes that the level of grit someone has will contribute positively or negatively to a team's ability in winning games (or achieving success). It is hypothesized that a team with players that have a higher grit score average, will have more wins than losses as compared to a team with a low average grit score. In order to test this hypothesis, five teams (each of a different sport) will be studied. These sports include volleyball, basketball, soccer, field hockey, and lacrosse. Each team will contain fifteen players with similar athleticism, and coaches with similar years of experience and skill level. Additionally, each team will participate in ten games against other teams in the same league with equal abilities. Ultimately, it is expected that after the season is over - and the individual average grit scores are calculated - the team with the highest average grit score will lose only one or two games. Comparatively, the team with a low average grit score will lose more games than they will win. This suggests that the amount of grit individuals have will contribute to the team's overall performance, and shows how successful the team is. Furthermore, future research could be conducted and include a focus on individuals who play a sport individually rather than on a team.

Convent of the Sacred Heart
Mary Musolino, Teacher

Emily DeNunzio

Project #26

Research Proposal, Science, Health and Medical

Anterior Cruciate Ligament Surgery and Recovery Survey

The Anterior Cruciate Ligament (ACL) is a ligament in the knee that connects the femur bone to the tibia bone, prevents excessive forward movement, and provides lateral stability. The knee is a hinge joint and cannot extend greater than 180 degrees, so the ACL prevents the knee from over extending. When injured the ACL often requires surgery with an average recovery time of one year. There are about 150,000 female soccer athletes that tear their ACL's yearly. There are four main types of surgery techniques. Three of the surgeries use a graft, which could be the patella tendon, quadriceps tendon, and hamstring tendon graft. The last technique is the Bio-Enhanced ACL Repair. The objective of this experiment is to determine which type of surgery yields the shortest recovery, fewest complications, lowest occurrence of future complications, and least amount of overall pain. Previous studies on ACL repair and recovery have been conducted on female basketball athletes, but this study will be on female soccer athletes. Data will be gathered through the administration of a survey containing questions about type of surgery, postoperative problems, rehab time, and other injury information. Each category will contain several more specific questions. This survey will be administered to female soccer athletes between the ages 12-24. The results of this study will identify any correlations between surgical repair method and quality of life, and may be used to suggest more efficient recovery strategies for rehabilitation specialists. The results will suggest what areas of ACL injury and treatment merit further research in an effort to reduce the occurrence of such injuries, and improve the recovery outcomes and times of athletes experiencing ACL injuries.

Darien High School
Guy Pratt, Teacher

Leanna Crafford

Project #27

Completed Project, Science, Health and Medical

Effects of 25-hydroxycholesterol and 27-hydroxycholesterol on alpha-synuclein expression in cortical astrocytes

An estimated 15% of the United States population over the age of 65 are susceptible to developing neurodegenerative diseases such as Alzheimers and Parkinsons. While there are therapies to suppress symptoms, there is no cure to reverse brain damage. Lewy bodies, or abnormal alpha-synuclein protein clumps, are often found in excess in patients with neurodegeneration. By understanding what affects alpha-synuclein expression, researchers will be closer to curing neurodegenerative diseases. 25-hydroxycholesterol and 27-hydroxycholesterol were applied in various concentrations to astrocytes cultured from mice cortices to test the effect on alpha-synuclein expression. SDHA treatment was used to normalize the data. SCP-2 and ABCG1 were tested as positive controls. Following the treatments, cDNA was created from the cells. The area in the cDNA responsible for alpha-synuclein expression was multiplied through PCR to determine how much synuclein would accumulate in the living cell. From the results, it can not be concluded whether the varying concentrations of 25-hydroxycholesterol and 27-hydroxycholesterol have an effect on alpha-synuclein expression in the brain due to inconclusive results. While the 25-hydroxycholesterol controls were successful, the alpha-synuclein gene expression results were inconclusive. The positive controls and the alpha-synuclein gene expression results of the 27-hydroxycholesterol treatment were both inconclusive. Upon further analysis of the results, it may have been possible that the cortical astrocytes used in the study were treated with 25-hydroxycholesterol and 27-hydroxycholesterol for too long, altering the cell lifespans. A shorter life span could interfere with data collect, leading to inconclusive results. Over a one year period of time, the study will be rerun using different treatment times to remove interference with data collection.

Ridgefield High School
Ryan Gleason, Teacher

**William Russell
James Johnson**

Project #28

Research Proposal, Engineering, Physical Science

Invisibility Cloak

We want to propose a flexible metamaterial to be constructed in such a way that visible light waves bend around it, resulting in the material being invisible. We wish to do this because researchers have created rigid small-scale metamaterials capable of invisibility, but nothing larger or more flexible. We will approach our problem by researching how metamaterials are designed, and design our own. Furthermore, we will ensure that the components of our design and its structure enable the metamaterial to be flexible. Our results will be presented as our schematic, complete with a written explanation of why we designed our cloak the way we did. The findings will include a summary of the metamaterial research we conducted, in order to provide background for the audience. A flexible cloaking device, if adapted to fit the human form, could protect the lives of American soldiers and law-enforcement officers by rendering them invisible to the enemy. Additionally, a cloak impermeable to visible light could be modified to be a cloak impermeable to infrared radiation- heat-proof protective attire.

Darien High School
Matthew Buchta, Teacher

Eva Murphy

Project #29

Completed Project, Science, Health and Medical

Embryonic chick forebrain neurons as a model system to visualize the localization of L1CAM protein mutations

CRASH syndrome is a disorder associated with a mutation in the L1CAM gene. The L1CAM gene instructs how the L1 protein develops. L1 protein is vital in the organization of neurons, the development of myelin sheath and the formation of synapses. Humans with L1CAM mutations grow up with a significant developmental disability. I believe that L1CAM protein mutations will localize in different areas of a neuron when compared to non-mutated L1CAM proteins. Culture plates and chicken embryo forebrain were prepared. Mutant DNA was added and transfected. Cultures were incubated with the primary antibody, 5G3. Cultures were permeabilized and incubated with secondary and tertiary antibodies. Observations were made on a microscope and digital images acquired. Average pixel intensity was measured along each drawn line segment and pixel values analyzed. Currently, from visual data we have concluded that the P941L mutation localized along the axon as expected. The D544N mutations localizes in cell soma, which was not expected. This is because the mutation likely causes the protein to change shape and get stuck inside of the endoplasmic reticulum; therefore, causing the mutation to localize in the soma. Discovering where these proteins and mutations are expressed will have a societal impact by providing a launching point for further research. We can then look at what types of proteins lead to the mutations localizing where they do, which in turn provides more insight into CRASH syndrome and how it works.

Ridgefield High School
Ryan Gleason, Teacher

Sofia Piriz

Project #30

Research Proposal, Science, Behavioral

Determining Differences in Choice Blindness by Gender and Age

Choice blindness is a phenomenon in which people are blind to their own choices and preferences. The purpose of this study is to test choice blindness by age and gender. The first part of this experiment will examine 2 gender-matched groups of 30 people each within the age ranges of 18-30 and 40-52. The second part of this experiment will examine 2 age-matched groups of 30 women and 30 men. A standard way of determining choice blindness is to show each person two pictures at a time of similar looking women or men. The participant will be asked to pick the "more attractive person." There will be a pause and the person will be asked to justify his or her choice of the favorite. However, a substitution of the favorite will have been made prior to the explanation without the participant knowing. If the participant is unable to discover the difference in the new picture, then they are prone to choice blindness. It is expected that for the age portion, the younger age group will be more prone to choice blindness as opposed to the older age group. It is also expected that for the gender portion, men will be more prone to choice blindness compared to women. This study will add to current research on choice blindness and will reinforce the need to make educated choices and to question our gut instinct rather than simply accepting what is presented.

Convent of the Sacred Heart
Mary Musolino, Teacher

Katharine King

Project #31

Research Proposal, Science, Health and Medical

The Effects of Myxococcus Xanthus Encapsulin on Iron Accumulation and Cellular MRI When Expressed in Mouse Cells

There is a lack of noninvasive reporters and contrast for MRI. If Myxococcus xanthus encapsulin is able to create stronger signals for MRI when expressed by eukaryotes (by increasing iron accumulation), then using it could provide a noninvasive alternative to current methods used for MRI. That would help to further biotechnology and medical techniques, allowing for much more progress to be made in those fields with safer conditions. The gene for Myxococcus xanthus encapsulin will be inserted into a mouse cell via a lentivirus (inserts a lentiviral vector containing the gene). After the altered cell has replicated, the cells will be inserted into a mouse and both it and an unaltered mouse will be viewed under MRI and transmission electron microscopy to see signal strength for MRI and iron accumulation. I expect that there will be increased amounts of iron in cells due to the expression of Myxococcus xanthus encapsulin (which will be shown when viewed by transmission electron microscopy) and that the increased iron accumulation will provide a stronger signal for cellular MRI to detect. If Myxococcus xanthus encapsulin is able to be expressed in eukaryotic cells and provides a stronger signal for MRI to detect, then it could be used in other areas of research. The encapsulated ferritin could track specific kinds of cells, such as stem cells, and provide clearer and more detailed MR images all while being much less invasive than current methods.

Ridgefield High School
Ryan Gleason, Teacher

David Landry

Project #32

Research Proposal, Science, Environmental

Measuring how the concentration of saccharides in *Phaseolus lunatus* are effected by the concentration of CO₂ in the air

Measuring the effect of carbon dioxide will allow us to determine a causation, and if it does effect the sugar, sweeter crops can be grown and farmers can grow organic, low-sugar crops for the people that want to eat healthier. grow the lima beans, harvest the beans when they are ripe. Mass the beans. Mash beans and put them in water letting the sugar sink to the bottom. Dehydrate sample of sugar through heat, mass the sugar. I have not finished Measuring the effect of carbon dioxide will allow us to determine a causation, and if it does effect the sugar, sweeter crops can be grown and farmers can grow organic, low-sugar crops for the people that want to eat healthier.

Joel Barlow High School
Katherine Nuzzo, Teacher

Giara Henry

Project #33

Research Proposal, Science, Environmental

Controlling the Growth of *Phragmites australis* through Natural Methods

Phragmites australis is a problematic invasive species, especially in North America. The plant can crowd out native vegetation and therefore reduce plant biodiversity. The purpose of this experiment is to determine the most efficient natural substance that would limit the growth of *Phragmites* without putting the plants and wildlife around it in danger. It is hypothesized that natural substances with low pH and high pH will limit growth and prevent the spread of *Phragmites*. The low pH items to be tested will have lower pH than the gallic acid secreted by *Phragmites*. In addition, it is known that *Phragmites*' roots release an acid to kill other plants around them, thereby allowing themselves to overgrow. Adding substances with a high pH will neutralize the acid, thus restricting the harm to other plants and preventing overgrowth. It is expected that the addition of these substances will reduce the number of *Phragmites* that survive. Each week, five plants for each of the eight variables to be tested will be supplemented with the test substance in extract form. Water will be used as a control for the remaining five plants. It is expected that as each week passes, the number and quality of *Phragmites* plants will decrease for all trials except the control. The substances will likely vary in success, with the highest and lowest pH substances being the most successful. The spread of *Phragmites* is rapid and difficult to control. It chokes out native species and reduces food sources for some birds. By restricting the growth of *Phragmites*, more useful plants will be able to grow and biodiversity will increase. This will benefit the environment, including humans, animals, and other wildlife.

Convent of the Sacred Heart
Mary Musolino, Teacher

Jasmine Moon

Project #34

Completed Project, Science, Health and Medical

Synthesis and in vivo Evaluation of an Aromatase Inhibitor as a PET Radiotracer

Aromatase is an enzyme in the brain that catalyzes the synthesis of estrogens from androgens. The first aromatase inhibitor PET radiotracer [11C]-Vorozole presented difficulties like complicated synthesis of precursors. Therefore, a novel PET probe [11C]-Cetrozole was evaluated. The aim of this study was to test new C-11 labeling method: cyanation using H¹¹CN, develop new PET radiotracers with improved binding characteristics, and develop F-18 labeled radiotracer with extended half-life. Studies on aromatase can potentially explain gender differences in central nervous system (CNS) diseases like depression. Two precursors, substances made to use in another chemical reaction to produce the final compound, were developed with bromo- and iodo-analogs. Cold standards are compounds that have same chemical structures as real radiotracers, but with no radioactivity. Distinct two-step reactions were completed in order to synthesize both the precursors and the cold standard. To better understand the distribution, regulation, and functions of aromatase in brains, a non-invasive functional imaging technique, positron emission tomography (PET), was used in vivo. In PET, radiotracers bind with neuroreceptors or enzymes and emit γ -rays, which can be translated into images. Two precursors and one cold standard of [11C]-Cetrozole were successfully synthesized and will be used for further experimentation with radioactivity. Recently, the connection between brain aromatase functions and non-reproductive conditions has been revealed. Therefore, the developed compounds will be assayed for binding affinity, and potential candidates will be labeled and evaluated in vivo using PET. The developed radiotracers can image the aromatase behavior in the brain, potentially diagnose breast cancer at an early stage, and potentially discover cure for neurological and emotional diseases like cocaine addiction and depression.

Amity Regional High School
Deborah Day, Teacher

Manvi Malhotra

Project #35

Research Proposal, Science, Health and Medical

Cognitive factors contributing to reaction time in children with prenatal alcohol exposure

This study aims to examine if prenatal alcohol exposure (PAE), affecting 2-5% of all children, will affect simple reaction time due to cognitive deficits. Reaction time is an essential component of physical activity, brain activity, and behavior, representative of cognitive function as a whole. It is hypothesized that children with PAE will have lower reaction times than children without PAE due to poor coordination in relation to cognitive deficits. Two groups of children, one with and one without fetal alcohol spectrum disorder (FASD), ranging from ages eight to sixteen, will partake in a series of tests that analyze reaction time. To test simple reaction time, in the Attentional Performance Test virtual visuals will appear and the child's response to it will be timed over several trials. Similarly, auditory tests will be conducted using the EKHO system, a reaction time analysis tool, as well as the Timed Up and Go physical performance test and the Addenbrooke Cognitive Examination. The projected results are that children suffering from FASD will perform significantly worse than children without PAE due to detrimental cognitive deficits. Both groups will improve with each trial as muscle memory increases until the results stabilize at the true reaction time. With data suggesting slower reaction time, the effects of alcohol consumption during pregnancy on children can be quantified and linked to cognitive disability. Children with slow reaction time often have trouble in daily life ranging from athletic activity to driving. This study will make it clear that PAE is a danger and will lead to further studies looking more specifically at complex reaction time, gender, or other cognitive functions like motor coordination, or problem solving.

Darien High School
David Lewis, Teacher

Stephanie Jordan

Project #36

Research Proposal, Science, Environmental

Determining Water Quality in the Byram River Adjacent to a Golf Course Using Macroinvertebrates and Nutrient Testing

The quality of water flowing into the Long Island Sound from rivers and streams needs monitoring. The purpose of this study is to measure the nutrient levels and types of macroinvertebrates in a region of the Byram River adjacent to a golf course in order to determine the water quality. It is hypothesized that the water quality in the Byram River will be affected by the runoff from an adjacent golf course, particularly affecting macroinvertebrates and nutrient levels. Specifically, it is hypothesized that there will be an increased amount of phosphorous, nitrogen, and chlorophyll A downstream from the golf course compared to upstream. In addition, it is hypothesized that there will be a decrease in dissolved oxygen due to algae growth downstream from the golf course compared to upstream due to greater nutrient levels. Finally, a lower proportion of macroinvertebrates downstream from the golf courses compared to upstream is predicted. This study is significant because annual occurrences of low dissolved oxygen levels in the Long Island Sound create less than ideal conditions for some marine organisms. Since golf courses are sources of nitrogen that may decrease dissolved oxygen levels, further affecting the water quality, this study is an important one.

Convent of the Sacred Heart
Mary Musolino, Teacher

Angelique Starke Chelsea Beckford

Project #37

Research Proposal, Science, Health and Medical

Using DNA Barcoding to Detect Potential Mislabeling in the Baby Food Industry

Based on literature research conducted, it was discovered that the primary ingredient listed on baby foods and infant formulas may be substituted for a cheaper or more common ingredient. In this study, it was hypothesized that the primary ingredient listed on premium stage-3 and stage-4 foods will be substituted for another less expensive ingredient, such as apples. Stage-3 and -4 foods have been chosen for this study due to the greater likelihood that the DNA has not been overly processed and thus can be identified through DNA barcoding. The DNA from many different types of premium baby foods will be isolated, amplified, and sequenced and the primary ingredient analyzed and compared to the label. It is expected that approximately 20% of the foods tested will be mislabeled. This study is important because barcoding baby food is a tool to safeguard the health of infants and young children. This can help in food traceability, to safeguard public health, and to vouch for the quality control of food products.

Convent of the Sacred Heart
Mary Musolino, Teacher

Jeremy Bachman

Project #38

Research Proposal, Science, Behavioral

The Effect of Fonts on Test Scores

The CRT is a three question test used to measure one's cognitive ability. The CRT is only being used as a basis for the test being given to the participants. Three of the four questions are from the CRT, and one was selected because it, like the other questions, doesn't require any advanced mathematics or comprehension. No study has been reported investigating the correlation between font style and test scores. The purpose of my proposal is to investigate the correlation between font families and test scores. My hypothesis is that the more intricate the font is, the slower the question is read and the higher the test scores will be. This is because more difficult to read fonts force the reader to slow down, therefore understanding, and comprehending the question better. The independent variable is the font the text is in (either Arial, Times New Roman, Yellowtail, or Monoton; these fonts are organized in increasing intricacy), and the dependent variables are the number of correct answers, and the time it took to read and answer each question. The participants will receive four slips of paper, each with one question on it, each question will be in one of four fonts. Each participant will receive all fonts, however the font will not be the same for each question. For each question, the duration at which the participant reads and answers the question will be recorded. Analysis will determine whether there is a correlation between correct answers and font, time and font. Results from this experiment will hopefully shed light on how test results can be improved through modification of font style.

Amity Regional High School
Catherine Piscitelli, Teacher

Nicole Alindogan

Project #39

Research Proposal, Science, Health and Medical

Growth Suppression of Cancerous Cells Through the Combination of Tamoxifen and Gamma-secretase Inhibitor

Cancer treatments today, including chemotherapy and radiation, have a wide range of side effects that can lead to immunosuppression and recurring cancer. A lesser known breast cancer treatment uses tamoxifen to regulate estrogen levels of the patient. Tamoxifen treatment has been found to induce a dependency on the Notch system for proliferation, so combining the two would target two mechanisms necessary for the cancer to grow, and cause cell death. There has been limited research using Gamma-secretase inhibitors in combination with other drugs, and tamoxifen has been known to treat certain breast cancers. I would test a combination of the two on MCF-7 and ZR-75 cell lines, then measure the cell viability to determine the cancer's reaction to the drugs. Depending on the results, I would test different amounts of the drugs to find the most effective ratio. I predict that the luminal B cancer (ZR-75) would be more difficult to induce cell death in because of its high levels of Ki67 proliferation proteins and the more unresponsive tendencies to endocrine therapy. However, I do expect the MCF-7 line to be very responsive and still believe that the combination of tamoxifen and GSI will be more effective than either of the two drugs on their own. If this research on the cell lines is successful, more research would be opened up about the efficacy of combination therapy. This means that more anti-cancer drugs will be combined with each other and a more effective treatment can reach clinical trials. Also, tamoxifen is already being used in breast cancer treatment, so its toxicity and side effects are already found to be minimal.

Ridgefield High School
Ryan Gleason, Teacher

Alex Price

Project #40

Research Proposal, Science, Environmental

Modelling Permafrost Degradation Using Changing Environmental Factors

To develop a model that foresees the amount of permafrost degradation in the future using changing environmental factors. This is important because there is much more research to be done on this specific topic. Pursuing this research can really help the field of climate change. This research can do this by giving projections of amounts of methane emissions, and how this could change the increase in temperature. I am going to study past models and information that has to do with wetland sources of methane, and climate change. I am going to create a conceptual model of a basic scientific process. Then I will create one on permafrost degradation. Then, with help from my mentor, I will use knowledge from this and data from data banks to create a permafrost model in excel. Based on broad studies, and models, There will be an increase in the amount of permafrost degradation. With the current trend, I expect to see an almost exponential increase in the degradation. This will vary as new studies come about with new information. The information the model will contain could be used as great help for researchers in this field. The different possible scenarios of permafrost degradation can provide valuable information for slowing down global warming. It would do this by showing how much the degradation is increasing by, and what that is doing to the increase in global climate.

Ridgefield High School
Ryan Gleason, Teacher

Olivia Yoo

Project #41

Research Proposal, Science, Health and Medical

Beta-amyloid antibody in late stage Alzheimer's disease

Alzheimer's disease (AD) is a debilitating neurodegenerative disease that affects over 5 million people in the United States, yet has no effective treatment or cure. One theory for the mechanism of AD is the amyloid hypothesis, which states that the beta amyloid protein (A β) is the cause of the disease. Previous clinical trials have been performed using the beta-amyloid antibody aducanumab in patients with early stages of AD, which demonstrated a slowed progression of dementia and reduction of the levels of A β . If aducanumab is administered to late stage AD patients, it will reduce the levels A β and prevent the symptoms from becoming more severe. Patients will receive varying doses of aducanumab and placebo (saline) via IV. The size and health of the patients' brains will be assessed and monitored using magnetic resonance imaging and computed tomography. Positron emission tomography will be used to monitor the levels and location of A β in the brain using the tracer florbetapir. Cognitive tests such as the Clinical Dementia Rating and Mini Mental State Examination will be used to monitor the patients' symptoms and level of dementia. Similar to previous studies, levels of A β are expected to decrease with administration of aducanumab. The progression of dementia will slow, however, symptoms are not expected to reverse or improve due to the patients being in the late stages of AD. This study is expected to provide more evidence towards the amyloid hypothesis to better understand the mechanisms of AD and role of A β . The results will be used to illustrate the similarities and differences between early and late stages of AD, and indicate how the disease develops in the brain over time.

Darien High School
David Lewis, Teacher

Ariel Gianukakis

Project #42

Completed Project, Science, Environmental

The Efficacy of Lichens as Bioindicators of Air Pollution in CT

Air pollution is a major issue in the environment due to cars and burning of fossil fuels. Ozone and Fine Particulates also cause respiratory and cardiovascular diseases. Different lichen species have varying tolerances to pollutants in the air, therefore making them bioindicators. The purpose of this experiment is to determine the effectiveness of lichens as bioindicators of air pollution in Connecticut. Based on the hypothesis that the abundance of lichens is affected by air quality, the prediction was tested that areas with increased fine particulates and ozone levels will have a lower abundance of foliose lichens. Yearly air quality measurements were obtained from the Connecticut Department of Energy and Environmental Protection for four testing sites in the towns of Cornwall, New Haven, Danbury, and Westport. At each site, a 100 m² plot was divided with transects every 10 meters to create a grid of 16 sample points. At each transect, a 5 meter rope extending from the center of the sample point was used to indicate a circular sampling area. Within the sampling area, lichen abundance was determined using a point-intercept method on all trees encountered with heights above 20 feet. Data was analyzed using a Chi-Square Test of Independence and a correlation analysis was used to determine the relationship between lichen abundance, ozone, and particulate levels. The abundance of foliose lichens were strongly correlated with PM 2.5 levels, but not ozone levels. The results indicate that the abundance of foliose lichens can be used as a bioindicator of air quality. Due to the slow growth rate of lichens and varying age of test sites, future work for this experiment includes testing sites of the same approximate age.

Darien High School
Guy Pratt, Teacher

Danielle Grosso

Project #43

Completed Project, Science, Environmental

The Impact of Local Vegetation on Nest Height

Saltmarshes are important ecosystems that support many species of animal life. Among those are the Saltmarsh Sparrow (*Ammodramus caudacutus*), Seaside Sparrow (*Ammodramus maritimus*), Willet (*Tringa semipalmata*), and Clapper Rail (*Rallus crepitans*), all of which nest in or around the saltmarshes, often on the ground. This project will investigate the relationship between the height of vegetation surrounding the nest and the height of the nests. The independent variable will be vegetation height and the dependent height of the nest. I will analyze height of surrounding vegetation and height of the nest using means, medians, ranges, correlations, regression analyses, and using Microsoft Excel with data collected by SHARP. I will average the vegetation height surrounding the nest and the distance from the bottom of the nest to the ground to find the height of the nest. I will be using these two data columns as my x-axis and y-axis for correlation. Data trends thus far show positive correlation between between the height of surrounding vegetation and the height of the nests for the willet, salmarsh and seaside sparrows, but negative correlation for the clapper rail. The two largest factors of population decline are predation and nest flooding, both direct results of nest height and placement. Because of the decrease in populations of aforementioned marsh birds, it is vital that we understand the factors that cause nests to survive, and those that cause nests to fail. If equipped with this knowledge, scientists could predict populations and implement parameters for better protection, thus increasing population.

Amity Regional High School
Deborah Day, Teacher

Julia Driscoll

Project #44

Research Proposal, Science, Health and Medical

The Effect of Low Level Laser Light Therapy on Genetically Corrected Skin Grafts for the Treatment of Recessive Dystrophic Epidermolysis Bullosa

Recessive dystrophic epidermolysis bullosa (RDEB) is a genetic skin disease characterized by severe blistering and loss of skin. It can be treated by genetically correcting a patient's cells to create a skin graft. However, the graft does not incorporate well into the skin. The purpose of my experiment is test whether using low level laser light therapy (LLLT) on RDEB skin grafts will increase collagen levels, hence, increasing their graftability. In order to carry out my research, I am going to be using genetically corrected RDEB fibroblast and keratinocyte monolayers and will be exposing some of these cell lines to LLLT. After doing this, I will be performing PCR on the cells. Once the PCR is completed, the amount of collagen VII in the different samples will be quantified through the use of Western blot and ELISA. The results of my experiment will likely show an increase in collagen VII in the fibroblast and keratinocyte lines exposed to LLLT. LLLT has been shown to stimulate the production of collagen in normal cells, so I do not believe genetically corrected cells will be any different. Additionally I expect that the fibroblasts will show a larger increase in collagen because they are the main collagen producers in the skin. My research will provide a starting baseline for the combination of LLLT and treatments for RDEB. My results would allow experiments testing the graftability of LLLT exposed skin grafts to be tested in vivo, in order to get closer to finding a more effective treatment for RDEB. Additionally, the idea of combining LLLT and skin disease treatments could be expanded past just RDEB to other incurable diseases as well.

Ridgefield High School
Ryan Gleason, Teacher

Bettina Hervey Project

#45

Research Proposal, Science, Behavioral

The Effect of Word Type and Complexity in the Primacy and Recency Effects

The tendency to remember items from the beginning or end in a list of items instead of the middle are referred to as the primacy and recency effects, respectively. The purpose of this experiment is to discover whether word complexity and word type affect whether people are more likely to remember words from the beginning or end of various lists. This study will specifically compare the recall of simple and complex adjectives, simple nouns to simple adjectives, and the percent recall of positive versus negative adjectives. If given a list of simple adjectives or simple nouns, a person will be more likely to remember the words at the beginning and end of the simple list, but if given a list of complex adjectives or complex nouns, the recall of the complex list will be inconsistent. If given a list of positive and negative simple adjectives, a person would be more likely to remember negative words if they consider themselves to be pessimistic, and positive words if they consider themselves to be optimistic. To test each category of adjectives or nouns, each list of words will be relayed to 50 participants one word at a time. After a brief set amount of time, the participants will be asked to recall as many words as possible and the responses will be documented, the percent recall by word graphed, and the graphs analyzed. Participants will also be given a survey to gather information about their personality type. The primacy effect has been shown important in employment and interviewing situations. This study can add to the body of information that currently exists on the topic.

Convent of the Sacred Heart
Mary Musolino, Teacher

Abigail Slanski

Project #46

Research Proposal, Science, Behavioral

The Effect of Altered Personality Perception on Time Efficiency of a Group Task

Personality assessments are a common sight, appearing in our social media as a constant pull to viewers. Many people believe these general, unspecific statements. How far does this belief extend, and how can it be used? This experiment has been designed to test if one is told they have specific traits, will they be more likely to demonstrate them. In this experiment, people will be tested to see if the result of the big five personality test they've been given will influence their performance in a group activity. While studies have shown giving similar statements has little impact on performance in a logic based test, it can still influence other factors that would be more relevant to a teambuilding activity such as confidence or work ethic. It is predicted that if a group is told they tested positive for skills necessary to a task, they will complete the task more quickly as compared to if they were not told so. This will be tested by having a group of participants take the big five personality test and sorting them into groups based on results: positive for a specific social trait, negative, and a group of mixed. All participants, however, will be told they tested positive for the trait and given an analysis of the faux personality. The groups will be timed as they build a tower meeting specific requirements. These times will be compared to groups who were not read their results. The independent variable is the participants legitimate result of their personality test, and the dependent variable is the time taken to complete the task.

**Amity Regional High School
Catherine Piscitelli, Teacher**

Victor You

Project #47

Research Proposal, Science, Physical Science

The Effect of Left Lane Usage Laws on the Number of Traffic Accidents

Many people in the US use cars to travel. However, they always have to plan for car accidents and congestion. There has been many actions every state has taken to try to reduce traffic accidents and congestion, such as carpool lanes. However, there are many different laws dictating the usage of left lanes. Studies have shown that frequent lane-changing leads to more accidents than speeding. How fast a car in the left lane is could determine how much surrounding cars need to change lanes because if there is a slow car in the left lane, faster cars need to change lanes to get around that car. Is there a relationship between certain left-lane usage laws and the number of traffic accidents? If a state has a law that limits usage of the left-lane to passing only, then the number of traffic accidents will be lower than in those states with less strict laws. The fifty states will be divided into groups. These groups will all have similar left lane usage laws, and the highways observed would be located near a city, have 2 lanes, and the same speed limits. Various databases will be used to find the number of traffic accidents in all of the fifty states for 2011-2014. A state's number of traffic accidents would then be divided by the number of vehicle that drove on that highway. These process would be repeated for all fifty states. This data could be used by state lawmakers to pass a left-lane usage law that ultimately reduces traffic accidents and congestion.

**Amity Regional High School
Catherine Piscitelli, Teacher**

Talia Barry

Project #48

Research Proposal, Science, Physical Science

Effect of container type on the pH of water

Most people consider water “bad” after it has been left out for a day or two. The water may not be in the ideal condition for human consumption or people believe it is unhealthy to drink. The pH or acidity of the water is what changes over time. What variables will affect the pH of water over time? If the container and temperature of the water is changed then the pH of the water will also change. In this experiment the container holding the water will be changed resulting in the pH of the water changing. The containers will be plastic, glass, and stainless steel. Each container will have three groups, one in a cold environment, one at room temperature and the last group will be heated once. After each day the water is left in the container the pH will be measured and recorded. Over time it will become apparent which containers cause a change in pH and how each temperature effects this. To answer the original question the amount of water in the containers needs to be kept the same. Also, each container will be covered and about the same size and shape. The pH before and after the water is left in the container will be measured. Then the change in pH can be calculated. This will give results as to which container creates more of a change in the pH.

Amity Regional High School
Catherine Piscitelli, Teacher

Brielle Racanelli

Project #49

Research Proposal, Science, Environmental

Migratory Movements of Humpback Whales and the threat of Shipping Routes across the Atlantic Ocean.

Humpback Whales are a critically endangered species of marine mammal that can be found in oceans all over the world. These whales every year migrate thousands of kilometers from breeding to feeding grounds. Some of these areas are not covered by Marine Mammal Sanctuaries, which were created to protect these whales. Due to the increase in commercial ships, Humpback Whales become threatened by these vessel. The purpose of these experiment is to find the places where shipping routes will become destructive to native Humpback Whales and to see which whales in a population are at the highest risk for ship interference. In these experiment 15-20 Humpback Whales will need to be tagged the Atlantic ocean. The whales will be tagging the Caribbean, which is their breeding ground, and will be tagged with Satellite Transmitters. Once tagged in the winter and spring the whales will be tracked until they made it to the feeding grounds up north. Data will also need to be collected at the same time of every commercial ship that passed through the Atlantic ocean. After all of the data is collected, it will be analyzed to see if or when the whales and the shipping routes will interfere with each other. The findings of this research will be display where the areas of most vulnerability of the Humpback Whales. The results will show that the most endangered whales are the ones close to the shores of cities with large harbors. These findings should be able to help establish new Marine Mammal Sanctuaries to help with the protection and get these marine mammals off the endangered species list.

Darien High School
Guy Pratt, Teacher

Alexandra Swift

Project #50

Research Proposal, Science, Behavioral

The Effects of Smaller Nesting Areas on the Green Sea Turtle Population

Recent studies have shown a dramatic decrease in the sea turtle population, as more sea turtles are hunted and killed for their skin, meat and shells. Sea turtles use beaches to lay their eggs, and false crawls, or failed attempts at nesting, are dangerous for the turtle, and conservation strategies must take into account the characteristics of sea turtle breeding grounds, because it's necessary in order to prevent green sea turtles from becoming endangered. The goal of this experiment is to find a new approach in preserving the green sea turtle population, by relating the surface area of Caribbean beaches to false crawls of a green sea turtle. Decreasing nesting areas are caused by environmental complications, such as sand erosion and rising sea-levels. Beaches with different surface areas will be observed and tested for false crawls through observation and track examination. Data will be retrieved from beaches on Caribbean Islands, and will provide additional information for researchers on what characteristics of turtle breeding grounds can be considered during population management. It is expected that with less surface area, there will be a greater amount of false crawls. Sea turtles are a vital part of the ocean ecosystem, especially green sea turtles, because they have wide-ranging migration patterns, and provide good global ocean health indicators. As the surface area of a nesting beach decreases, it forces the turtle to travel farther up the beach, bringing it closer to unnatural light and human activity, making the turtle more likely to false crawl, as even the slightest bit of unnatural activity can frighten a turtle back into the ocean.

Darien High School
David Lewis, Teacher

Nicole Greene

Project #51

Completed Project, Engineering, Physical Science

Measuring the Effectiveness of a PEM Solar-Electrolysis Fuel Cell System for Use in a Household

Due to the scarcity of fuel resources in the world today, and the harm these fuels are inflicting on the environment, there is increased attention towards clean, renewable energy sources that can be widely implemented. The purpose of this paper is to evaluate the efficiency of a Proton-Exchange-Membrane (PEM) solar-electrolysis hydrogen fuel cell system for use in a household environment as a clean and renewable alternative to modern-day electricity production. For the analysis, a PEM fuel cell was built and tested. The data from the fuel cell was analyzed using FuelCell View software. After testing the fuel cell, the rest of the data was obtained from scholarly journals. The data from the fuel cell and journals was used to compare the energy output of a PEM solar-electrolysis hydrogen fuel cell system to a lithium-ion battery used for solar-energy storage. The data obtained was used to compare the effectiveness of the PEM solar-electrolysis fuel cell system as an energy producer for a household to solar energy stored in a lithium ion battery for use to produce energy to fuel a home in order to determine which system is most effective for use in a household. This research adds to the current knowledge of fuel resources and clean energy sources. Hopefully, this analysis will add to the move towards clean energy usage and the implementation of similar systems to these to produce energy in the US and the rest of the world in household environments.

Ridgefield High School
Patrick Hughes, Teacher

Jacob Feuerstein

Project #52

Completed Project, Science, Health and Medical

Correlations Between Specific Gut Flora and Different Body Mass Type Changes

In researching obesity, which afflicts 35.7% of Americans, an important distinction to be made is between fat and lean mass. Several studies have discovered that different factors can lead to changes in lean or fat mass, while also impacting the gut microbiome. The purpose of this research is to determine if there is a correlation between different gut microbial populations and changes in lean mass compared to fat mass. Data from the experiment “Metabolic and Metagenomic Outcomes from Early-Life Pulsed Antibiotic Treatment” examines the compositions of various microbial bacterial species, as well as changes in both lean mass and fat mass in mice with these bacterial compositions. Therefore, this data will be analyzed in order to see if a correlation exists, and then for what bacteria the correlation for differences between lean and fat mass exists for. Preliminarily, several OTU’s, most significantly #36755 and #46649, were seemingly correlated with fat mass increases. Additionally, #29368 and #14322 were seemingly correlated with lean mass increases. Finally, #46649, #30936, and #30040 were all seemingly correlated with total mass. Interestingly, the data also shows several OTU’s that correlate against different types of mass increase. Most significant is the trend of #51819 against fat mass increases, and the trend of #19024 against total mass increases. Possible implications include a better understanding of the microbiome-related causes of obesity, and, as the microbiome is seemingly involved with these different types of mass, implications include an understanding on which bacteria are responsible for the various mass changes. The latter could be important in targeted obesity treatment, or better prevention. Additionally, trends like those of certain bacteria against fat and total mass increases give insight on potential bacterial modification strategies that can possibly reduce environmental obesity risks.

Amity Regional High School
Deborah Day, Teacher

Hannah Rappaport

Project #53

Completed Project, Engineering, Behavioral

Designing a Canine (Canis familiaris) Facial Recognition System of Emotions

As humans and dogs are in close contact either as pets or service animals, human-dog communication is a topic of high importance. Using the engineering design process, a facial recognition system was developed for canines. Communication between humans and dogs can certainly improve and many emotions of dogs can be misinterpreted. This system may improve the accuracy of canine emotion recognition. Videos were taken of volunteer dogs after behavioral situations were used to induce emotional expressions. The AUs (Action Units) for each ‘emotion’ were identified from the videos using DogFACS protocol. The Kinect for Windows was used to collect additional depth data. A system was programmed to recognize the facial expressions and recognize the AUs that determine the emotion of the dog. It then notifies the owner of the expressed emotion. Once the system was created, the accuracy was tested by comparing the emotion identified by the system to both the AUs determined in the video and to the emotion that should have been identified based on the behavioral situation the dog went through. The system was improved for accuracy after it was tested. Owners and dogs have a mutualistic relationship, therefore humans should better understand the quality of life of their dogs, just as dogs work to understand their owners. This system can teach owners how the behaviors of their dogs demonstrate their emotions. Ultimately, facial emotion recognition systems could be expanded for many species of domestic or zoo animals so that animals in human contact could be better understood.

Amity Regional High School
Deborah Day, Teacher

Nitya Bhattarai

Project #54

Completed Project, Science, Health and Medical

Regulation of Thrombus Growth by Factor IXa Distribution

In many poor countries such as Nepal, it can be hard to find proper medication and care for those who have rare bleeding disorders such as Hemophilia B. A goal of this research is to arrive at a better treatment for kids who do not have access to medicine at all times. What is the optimal mixture of FIXa with FIX to clot bleeding while also limiting adverse thrombotic events? Data has been retrieved from unpublished sources in the Food and Drug Administration. Data has been analyzed using Microsoft Excel. The increasing of the clot size is analyzed as a function of time which then will be graphed. The data was obtained from FDA as raw data. After the data was graphed, linear trend lines will be added. This will be used in analyzing the data and comparing the clotting rates. From the data, it can be understood that if the size of the activated factor is larger, then the clot will grow at a greater rate. The linear trend line for the 13nM shows the equation $y = 13.459x$ which is greater than the other, smaller sizes. This data supports the hypothesis that was presented in the introduction. Another finding that is supported by the data is the clotting is time dependent. Medicine that can result from this research may be able to better help people who have Hemophilia B immediately after they have bleeds. This is useful in places where access to this medicine cannot be met at a prophylactic basis. Medicine can be provided more efficiently. Rather than having to infuse prior to bleed, infusions can be done after bleeds.

**Amity Regional High School
Deborah Day, Teacher**

Felix Liu

Project #55

Completed Project, Science, Physical Science

The Effect of Climate Change on the Frequency and Intensity of Atlantic Storms

Storms such as tropical storms and hurricanes are part of normal weather activity in the Atlantic from June through November. In the past decade, record-breaking and extremely strong hurricanes, such as Hurricane Katrina, have formed over the Atlantic, and it has been attributed to climate change. The objective of this project is to determine the effect that climate change has on the frequency and intensity of Atlantic storms. The independent variable is the extent of climate change in the North Atlantic region and will be defined as average sea surface temperature (SST) change in Celsius. The dependent variable is the frequency of storms and their intensity. For the project, databases and Excel were used. The COBE-SST2 dataset was used to collect data for the mean average SST in Celsius of hurricane season for each year in the study (1962-2012) in three locations in the Atlantic. Data for frequency of named storms along with their intensities were from the HURDAT dataset. After all necessary data was collected, they were graphed on excel to visualize relationships and find trends within the data. El Nino and La Nina weather events were taken into consideration when graphing the data. Programs for statistical analysis were used to find the significance of the relationship between climate change and frequency and intensity of Atlantic storms. After collecting the necessary data, it has shown a temperature increase during hurricane season in the Atlantic over the years of the study, which shows climate change. The impacts and intensities of Atlantic storms within the time period are also expected to show an increasing trend due to the temperature increase. Results from the project could be used to make future projections of the frequency and intensities of storms in the Atlantic. The findings could further determine the effect of climate change on weather in the Atlantic region.

**Amity Regional High School
Deborah Day, Teacher**

Allison Fischman

Project #56

Completed Project, Science, Health and Medical

Taste Perception in Obesity: Understanding the Role of Physiological State, Macronutrient Intake, and Flavor Preference

Excess consumption of dietary fat and sugar is associated with dopamine signaling deficiency and altered reward processing/executive function. Supplementation with the fatty acid oleoylethanolamine (OEA) has been shown to improve these deficiencies. This experiment with OEA supplementation in overweight/obese individuals aimed to test the effects of flavor choice, dietary intake, and internal state on taste perception. Correlations between eating styles, mood and perceptual ratings were also analyzed. To accomplish this, 68 overweight/obese individuals aged 18-45 participated in six-week supplementation with OEA/placebo. After a fasting blood test, body measurements and internal state ratings were measured. A fixed meal was administered. Behavioral tasks and questionnaires measured impulsivity, outcome learning, reward discounting, eating style, anxiety/depression, and dietary intake. Participants tasted and rated aspects of puddings/Jell-Os with varied concentrations of fat/sucrose. Flavor choice for puddings and Jell-Os had an effect on perceptual ratings. Participants who experienced a larger increase in satiety rated the lowest concentration of puddings and Jell-Os as more liked. Participants with more depressive symptoms were drawn to higher fat and lower sucrose stimuli. High fat and sugar intake was related to greater liking for high concentrations of fat/sucrose. Diet was also correlated with eating style and BMI. Repeated measures ANOVA and MANOVA and correlation analysis were completed with IBM SPSS Statistics 22. This study found correlations between macronutrient intake, flavor preference, and physiological state. The results of this study will be used to help determine if OEA is an effective treatment for obesity and decreased dopamine signaling, altered reward processing, and executive function caused by excess consumption of dietary fat and/or sugar.

Amity Regional High School
Deborah Day, Teacher

Yusuf Ahmad

Project #57

Completed Project, Science, Physical Science

Zika Virus Infection in Pregnancy: A Mathematical Modeling Analysis

The Zika virus is the most recent arbovirus, viruses spread by arthropods, to reach the Western Hemisphere in the last two decades. The symptoms of the virus are very mild and are eradicated within two weeks. But recent studies have shown that the virus is very threatening for pregnant women as it can cause microcephaly or even fetal death. The purpose of this study is to create a deterministic model which will examine the dynamics of Zika transmission to pregnant women in North America. To create this model, an existing model from "Mathematical modeling of Zika virus" (Bonyah, Ebenezer et al, 2016) will be modified. Four more differential equations will be added to represent: Susceptible pregnant women, infected pregnant women, recovered pregnant women, and harmed infants. The same parameters will be used except they will be redefined to values of North America. These values will be taken from other studies. Once completed, the model will be implemented using MATLAB. The model will consider the exponential growth dynamics of ZIKV infection. With reasonable values for the parameters, the model will produce a qualitative analysis of all the dynamics of ZIKV transmission to pregnant women in North America. Findings can be used to determine the best way to avoid ZIKV infection for pregnant women as it is most threatening to them. The creation of such a model will help determine the dynamics in the spread and control of the Zika Virus and will give the best strategy for women in North America to avoid contracting ZIKV.

Amity Regional High School
Deborah Day, Teacher

Madison MacKay

Project #58

Completed Project, Science, Behavioral

How Reading Comprehension and Memory Skills affect Selective Attention and Cognitive Flexibility

The Stroop Effect tests selective attention and cognitive flexibility in different variations. First, the color word is in a different color. For example, the word “blue” would be written in green, and the subject would be required to say “green”. Second, the color word is in the same color. The motivation behind this project is to investigate whether improved memory and comprehension skills increase children’s attention span and the ability to face unexpected conditions in the environment. I will be testing how reading comprehension and memory skills affect cognitive flexibility and selective attention. Comprehension and memory skills are compared to the Stroop results to find correlations. Data from Woodcock III Passage Comprehension Test, Operation Span Test, and Stroop will be used to analyze and make conclusions. It is hypothesized that if memory and comprehension skills affect attention and cognitive flexibility, then better scores on the tests improve the Stroop score. There is no control in this study, and the materials I am using in this experiment are scholarly journals and data from the tests. For statistical analysis, the results will be analyzed using an ANOVA test. This project is designed to compare memory and reading comprehension skills to Stroop test. If better memory and comprehension skills correlate with a faster Stroop time, then the participant has a longer attention span and better problem solving skills. The projected results are that there’s a correlation between comprehension and memory test to the Stroop test. This data will provide insight as to whether or not better reading comprehension and memory skills improve cognitive flexibility and selective attention. This information is important because specific skills may benefit attention span and problem solving. This knowledge can be used to improve the attention and solving skills in schools by teaching children comprehensive and memory abilities. As children progress through school, they may become more capable of learning by using these skills.

Amity Regional High School
Deborah Day, Teacher

Keri Tenerowicz

Project #59

Completed Project, Science, Physical Science

The Effect of Different Textures of Coconut-Based Activated Carbon on the Adsorption of Dyes

Azo dyes in public waterways cause environmental pollution, which leads to diseases affecting people worldwide. However, activated carbon has been shown to adsorb pollutants in water. In this experiment, the texture of coconut-based activated carbon that would adsorb more azo dye in an aqueous dye sample was determined. This study is unique because these carbons and dyes were not previously combined for research. The independent variable was the texture of carbon, and the dependent variable was adsorption. The time of exposure, carbon per container, and concentrations of each dye were constants. There was a control for each dye. The powdered carbon was hypothesized to adsorb more dye. 0.5g of Procion and 1.5g of Dylon were dissolved separate samples of 500mL of water. Three Procion and three Dylon samples, each 50mL, were put into containers. 0.5g of powdered carbon were stirred into each sample. When the samples reached equilibrium after one week, the concentrations of dye were measured using Logger Pro 3® and Beer-Lambert Law Plots. These were subtracted from the initial concentrations. This was repeated with the granular carbon. The powdered samples were centrifuged after they reached equilibrium. Results found that the powdered carbon adsorbed significantly more dye through statistical tests. This may help industries choose a more effective texture of carbon to clean polluted water. Research was conducted at Amity Regional High School and at a house under the supervision of a teacher or parent. Dr. Penny Snetsinger aided in providing materials and interpreting the data.

Amity Regional High School
Deborah Day, Teacher

Jacob Silliman

Project #60

Completed Project, Science, Physical Science

The Fabrication of a Graphene Supercapacitor

Graphene is a fullerene consisting of bonded carbon atoms that form a sheet one atom thick. When there are many of these sheets stacked on top of each other, the surface area of the graphene greatly increases. This is important because when used as an electrode in a capacitor, graphene can greatly increase the capacitance of that device, ultimately making a supercapacitor. To make the electrodes of our capacitor, we must first yield these multi-layered sheets of graphene. This was done by thermally reducing graphene oxide on an aluminum foil substrate using a chemical vapor deposition furnace. We used these sheets of graphene as electrodes in an electric double layer capacitor. We used paper soaked in potassium hydroxide as a material that would be between the two electrodes acting as a sort of dielectric. Thus far, we have fabricated a control capacitor using just aluminum foil and a sheet of paper in the middle, a capacitor using just aluminum foil and a sheet of paper with the potassium hydroxide, and a capacitor with the graphene electrodes and the paper with potassium hydroxide. The tests proved that the capacitor with the potassium hydroxide held a higher capacitance proving the benefits of this dielectric-type material. Tests also showed that the capacitor with graphene electrodes greatly outperformed the other capacitors. Supercapacitors are able to hold hundreds of times the amount of electrical charge as standard capacitors, and are therefore suitable as a replacement for electrochemical batteries in many industrial and commercial applications.

Amity Regional High School
Deborah Day, Teacher

Kate Yuan

Project #61

Completed Project, Science, Physical Science

Analysis of Mercury Content in Sediments of New Haven Harbor

Mercury poisoning is detrimental to physical/neurological health. Coal burning, which occurs in New Haven Harbor is the main contributor of mercury contamination. The problem is where in the New Haven Harbor is there the most mercury, and how does loss on ignition affect mercury concentration? The independent variables are location in the New Haven Harbor and percent of loss on ignition (LOI)/silt. The dependent variable is mercury concentration. It is hypothesized that higher concentrations of mercury will be found in areas that are closer in proximity to metal input. It is further hypothesized that higher mercury concentrations will be found in areas with high percent LOI and silt. Fifteen samples were collected from different locations in the harbor, and were analyzed for mercury through atomic absorption spectrophotometry using the Milestone Direct Mercury Analyzer-80. Results show higher mercury concentrations in the innermost harbor, decreasing in the outer regions of the harbor. All but one sample station had a higher mercury concentration than the crustal abundance (0.06 mg/kg), but none showed a mercury concentration higher than the NOAA ERM (0.71 mg/kg). In addition, there was a positive correlation between percent LOI and mercury concentration, along with mercury concentration and copper concentration. Since all concentrations are below the ERM, marine life is not immediately threatened in this environment. However, because most of the concentrations are above crustal abundance and ERL, the mercury is the result of anthropogenic means. Regular monitoring of the harbor sediment and water is recommended to ensure that the ERM levels are not exceeded. Results can be used to evaluate the harbor environment and help in policy making.

Amity Regional High School
Deborah Day, Teacher

Elise Maro

Project #62

Research Proposal, Science, Health and Medical

Data Analysis of Perceived Limitations in Physical Activity of Youths with Inflammatory Bowel Disease

Inflammatory Bowel Disease is an autoimmune disease that causes inflammation in the digestive tract. Inflammatory Bowel Disease is hard to diagnose because the symptoms are not uniform amongst patients. Researchers are working on a cure for IBD, but have not reached one yet. They are specifically trying to find ways to manage symptoms and foster a greater quality of life for patients by investigating physical factors (disease activity, BMI, fatigue, etc.) and psychosocial factors (depression, anxiety, etc.). This research will attempt to show the correlation between perceived limitations in sports, like being unable to participate in sports activities, and physical and psychosocial health factors in patients with IBD. A cohort of 400 youths between the ages of 12-17 will fill out a baseline and one follow-up survey through CCFA Partners Kids and Teens about their age, IBD type, fatigue level, disease activity, body mass index, quality of life, IBD-specific anxiety, and internalizing symptoms (depression and anxiety). Data from these surveys will be analyzed using linear mixed models to examine the relationship between change in perceived limitations in sports and changes in psychosocial and physical health factors from baseline to follow-up. It is expected that perceived limitations in sports is associated with physical and psychosocial factors. This research will provide an understanding of the extent to which perceived limitations in physical activity are a problem for youth with IBD. Also, this research will potentially provide a better quality of life for patients with IBD and help youths with IBD participate more in sports. Future avenues of research may include designing an exercise regiment to add to current treatment for IBD to help increase the quality of life in patients.

Darien High School
Guy Pratt, Teacher

Kaitlin Edwardson

Project #63

Research Proposal, Science, Health and Medical

Using Lipids to Prevent the Aggregation of Alpha-synuclein in Lewy Body Dementia

Lewy Body Dementia (LBD) is an underdiagnosed disease that affects an estimated 1.4 million individuals and their families in the United States. The clumping of the protein alpha-synuclein may contribute to the onset of LBD. This experiment is designed to test the prevention of the clumping of alpha-synuclein into Lewy Bodies using various lipids. It is hypothesized that if different lipids are tested with alpha-synuclein using a spectrophotometer, several will demonstrate greater light transmittance when compared to the control, therefore demonstrating effectiveness against clumping. A microscope will also be used to view the possible prevention of the aggregation of alpha-synuclein. This study could provide a significant contribution to the treatment of LBD in the future.

Convent of the Sacred Heart
Mary Musolino, Teacher

Adrianna Davis

Project #64

Research Proposal, Science, Environmental

Using Stable Isotope Analysis to Estimate the Trophic Positions of Mackerel Sharks, Sand Tiger (*C. taurus*) and White (*C. carcharias*)

Populations of sharks, apex predators who play an important role in ocean biodiversity, have been decreasing due to human activity. Studies on shark diet are often facilitated through stomach content analysis, which does not give an accurate representation of long-term behaviors. The purpose of this study is to use stable isotope analysis, a computational study of carbon and nitrogen ratios, to assess the feeding patterns of two mackerel shark species. Tissue samples taken from the dorsal muscle of sand tiger (*Carcharias taurus*) and white sharks (*Carcharodon carcharias*), as well as their prey will be analyzed using stable isotope analysis (SIA). .5 mg of the freeze dried samples will be processed using a mass spectrometer. Isotopic ratios ($^{13}\text{C}/^{12}\text{C}$ and $^{15}\text{N}/^{14}\text{N}$) will be expressed as δ values. The expected results from the mass spectrometer would support the results from available stomach content analyses, as well as providing valuable information on the differences between the diets of sharks from the same order. This would be facilitated by isotopic ratios that would be used to estimate the trophic levels of the sharks, suggest the species' prey base, and make inferences on their inshore and offshore feeding patterns. Because marine food webs are more complicated, and thus more fragile, than terrestrial food webs, predator removals can have a detrimental effect on the stability of the ecosystem. Overfishing is a great threat to sharks, and in order for researchers to understand the evident importance of sharks in marine ecosystems, more studies need to be done on shark diet.

Ridgefield High School
Ryan Gleason, Teacher

Kevin Zhao

Project #65

Completed Project, Science, Health and Medical

Cardiac Motion Correction in Cardiac SPECT

Cardiac motion of the beating heart is a major confounding factor of image quality in cardiac imaging using Single Photon Emission Computed Tomography (SPECT). Existing cardiac gating methods compensates the cardiac motion at the expense of increased image noise. Therefore, new methods are needed to correct cardiac motion using all detected photons without increasing image noise. SPECT listmode data was divided to create 8 cardiac gated images based on heart motion and the heartbeat cycle. Non-rigid image registration was performed to deform all gated SPECT images to the reference gate, which was chosen to be the diastolic phase. Then all the deformed images was be averaged to create a motion-free image using all photons. Image resolution was evaluated in terms of the wall thickness of left ventricle myocardium. The image contrast is visually evaluated in terms of the ratio between myocardium and blood pool. The myocardial perfusion defect boundary and contrast were compared to the normal myocardium and used to investigate and evaluate the improvement of motion correction. Cardiac motion corrected images have higher image contrast, superior image resolution, and the same noise level, as compared to images without motion correction. For patients with perfusion defects, the defect boundary and size can be more accurately defined after improved imaging techniques have been performed on the data. Cardiac motion correction can improve image quality in cardiac SPECT. Through the improvement of SPECT imaging techniques, accurate diagnosis of coronary artery disease would be achievable, and early detection of the disease would be accomplished faster.

Amity Regional High School
Deborah Day, Teacher

Edward Criscuolo

Project #66

Completed Project, Science, Environmental

The Effect of Different Salinities Present in the Long Island Sound on the Settlement of Native Planulae

Jellyfish blooms can be detrimental to fishing, industry, and recreation, and are on the rise. The Long Island Sound is a unique habitat and houses the scyphozoan *Aurelia* sp. Understanding how the Sound affects jellyfish reproduction parallels understanding jellyfish blooms. One important aspect of scyphozoan reproduction is settlement, in which sexually-reproduced planulae settle into polyps. The research question is, "How do varying salinities affect the settlement of *Aurelia* sp. planula?" The experiment will be carried out the high school. Medusae carrying unreleased planula from the Maritime Aquarium will be lightly shook in water to release developed planulae. These planulae will be immediately transported back to Amity Regional High school and distributed evenly into three six well plates filled with room temperature seawater. Each pair of two wells in the six well plate will be filled with seawaters of different salinities. No data has been collected yet. However, to collect data, the amount of settled polyps in each individual plate will be counted using a dissecting microscope every two days for two weeks. At the end of the experiment, a Tukey HSD and an ANOVA test will be run to test for statistical significance of the collected data. The experiment will be repeated as many times as resources will allow for. This study will provide insight into the functioning of the Long Island Sound ecosystem and how environmental factors correlate with the degree of jellyfish reproduction and its consequential jellyfish blooms. Understanding this and knowing how predictable environmental occurrences such as rainfall will affect salinity will give information to recreational and commercial interests in the Long Island Sound on how to best predict blooms and therefore work their activity around them.

Amity Regional High School
Deborah Day, Teacher

Agrani Dixit

Project #67

Completed Project, Science, Health and Medical

Dissecting the Role of Desmosterol in Regulating Macrophage activation during Atherogenesis

Atherosclerosis is a disease which afflicts more than 3 million people yearly, where there is plaque build-up in the arteries that leads to a stroke, myocardial infarction, and death. The goal of this project is to understand how loss of protective desmosterol lipid intermediate is macrophage foam cells removes the anti-inflammatory breaks leading to chronic inflammation. The methods are to perform a bone marrow translation in *Ldlr* $-/-$ mice using wild type (WT) and DHCR24 TG bone marrow cells and assess atherosclerosis after feeding mice three months of high-fat containing Western diet. At the end of the feeding period, the lipid accumulation and size of atherosclerotic plaques & inflammatory markers in the artery wall will be determined by looking at cross sections of the aorta. Cell culture experiment techniques (mRNA analysis and Western blotting) are employed and characterized how the absence of DHCR24 influences atherogenesis. The size of atherosclerotic lesions and plaque using post mortem samples are analyzed as well. The projected results are that desmosterol mediates the anti-inflammatory response, then the amount of plaque buildup will be significantly lower than that of the wild type/control mice because of the decrease in inflammation. Results may show how desmosterol plays a crucial role to stop or lessen the plaque buildup in atherosclerosis. If it is shown that it does play a significant role to stop atherogenesis, then it can be used in combating the disease and for therapy options instead of invasive surgery. The prediction would be that elevation of desmosterol in macrophages by drugs will protect against inflammation and heart disease.

Amity Regional High School
Deborah Day, Teacher

Ulada Dubovik

Project #68

Completed Project, Science, Health and Medical

The Effect of Oxidative Stressors on Cultured Endothelial Lung Cells

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide. It is caused when the respiratory alveoli are exposed to external irritants that are no longer mitigated by cellular stress responses. It is unknown precisely in what way and when the irritants become too severe for the cells to mitigate. Therefore, my research will determine the effects of two oxidative stressors: cigarette smoke extract and hydrogen peroxide. First, cigarette smoke extract will be acquired by utilizing the cigarette smoke extract apparatus. Also, multiple samples of BEAS-2b cells (lung endothelial cells) will be cultured and placed in petri dishes with RPMI 1640, to provide them with the necessary nutrients and vitamins for survival. Once they are cultured, different concentrations of each stressor will be augmented. The control will consist of the cells untreated by any additional substances. A trypan blue assay will be performed, which is a live/dead discriminator, in order to see the effect of the oxidative stressors. The cells dyed blue will be indicative of those that died. The numbers will be used to see change over time and formulate a growth curve that is related to the concentration and the oxidative stressors implemented, in order to see the specific effects of cell viability. This research will contribute to the overall goal of seeing the mechanics of how COPD is caused. If successful, it will show the phases cells go through and at what point the cells are unable to battle with the stressors, thus leading to COPD. Since this disease is a frequent cause of death, finding out the mechanisms by which it begins on a cellular level is crucial towards curing it.

Amity Regional High School
Deborah Day, Teacher

Madelyn Pickett

Project #69

Completed Project, Science, Health and Medical

Underlying causes of Recurrent Corneal Erosion Syndrome in relation to the severity of the condition

Recurrent Corneal Erosion Syndrome (RCE) is a common condition where the front layer of the corneal epithelium detaches from the next layer, the Bowman's membrane. Multiple causes have been identified for this condition. This analysis will look at a relation between the underlying causes of RCE syndrome and how severe the case is through the complexity of the treatment. One hundred patients' past medical records would be used in this analysis. Using past history, each case would be looked at for one of the underlying causes. After distinguishing the cause of that specific case, the case's severity will be determined. This will be done by observing the treatment(s) the patient endured. The "severity" of the treatment increases as the treatment becomes more advanced. The categories of underlying causes will be put into subcategories based on severity. The subcategories of severity consist of the treatment levels (least to most severe): Antibiotic/Pain relievers, punctal occlusion, bandage lens, anterior stromal micropuncture, Phototherapeutic Keratectomy. The results of this analysis will show which cause of RCE syndrome is most severe. It is projected that the RCE patients with known past corneal events will have the highest severity. Findings of this study will help ophthalmologists to predict which RCE cases may be the most severe while just looking at the patient's past history. They may be able to determine the potential necessary treatment of the case ahead of time. This will then help help the patient to start treatment earlier and therefore risk further damage by waiting.

Amity Regional High School
Deborah Day, Teacher

Juliette Prato

Project #70

Research Proposal, Science, Health and Medical

Improving the Effectiveness of 3D Printed Bone Substitutes

Inkjet 3D printers are being used to create a bone-like material that could be used for bone grafts, dental work, and orthopedic procedures. Used with actual bone, it acts like a scaffold for new bone to grow on and will eventually dissolve with no apparent negative effects. The bone-like material acts like, feels like, and looks like real bone. Paired with actual bone, the bone substitute acts as a scaffold for new bone to grow on and ultimately dissolves. The purpose of this study is to extend advances made in 3-D printed octacalcium phosphate bone structures for implantation. Recent studies have used a series of chemical treatments to strengthen this bone substitute. Compression strength has improved in these studies but additional improvements can likely be obtained. It is hypothesized that by including a calcium-based solution within the series of solutions already tested, significant compressive strength and connectivity improvements will be obtained. In this study, the process of printing layer-by-layer bone substitutes using a 3-D printer will create a customized bone graft. Then the newly printed bone will be placed in various solutions and the compressive strength and connectivity to the recipient's damaged bone will be evaluated. This study is significant because it will improve the research pertaining to the use of 3-D printing bone substitutes for bone grafting.

Convent of the Sacred Heart
Mary Musolino, Teacher

Paolina Kovalenko-Baloup Project #71

Research Proposal, Science, Environmental

Testing the Quality of Drinking Water at Fracking Sites in New York, Colorado, and Pennsylvania

Fracking, or hydraulic fracturing, is the extraction of natural gas by fracturing rock using a pressurized liquid. This process has been negatively impacting the drinking water of those living in close radius of drilling sites. Families around America, specifically in New York, Colorado, and Pennsylvania, have experienced significant health issues due to affected drinking water. These health issues include lung disease, neurological damage, and day-to-day discomforts such as earaches and headaches. The drinking water had been previously tested and shown to be contaminated with toxic chemicals and not completely safe to drink. Research indicates that the drinking water may not have been tested over the past several years. The objective of this study is to update the research that has been done in the past to determine the current quality of the drinking water, which is hypothesized to contain contaminants. Water samples will be collected from residents who are affected by fracking sites and will be tested for chemicals associated with fracking, such as mercury, bromide, and lead. This study could provide residents in fracking areas with valuable information about the quality of their drinking water.

Convent of the Sacred Heart
Mary Musolino, Teacher

Rohan Patel

Project #72

Completed Project, Science, Health and Medical

Utilization of Q-2 Pressure System in Preventing Pressure Ulcers in Hospitalized Patients

Pressure ulcers are identified as a common and worldwide health problem that continues to inflict pain and discomfort to patients with increasing the cost of healthcare, even though most cases are predictable and preventable. Pressure ulcers affect 2.5 million people each year, and Medicare estimated each treatment added \$43,180 to a hospital stay. The root cause is not implementing constant pressure relief to affected skin on the body. I will be analyzing the data collected on Braden score (a number range that indicates susceptibility of developing a pressure ulcer), BMI, length of stay, and age, to come to a positive conclusion on the Q-2 system. To start, patients will be recruited as per the standard requirements. All patients are randomly selected for the control (no Q-2) or the experimental (with Q-2) group, and evaluated at end of study. With the random selection of patients, there were 187 experimental patients and 213 control patients in the study. It seems to be that the patients that underwent treatment using the Q-2 system had the best outcomes with shorter length of stay and decreased results of pressure ulcers (11-control, 2-experimental). The experimental group was tougher to treat, proving the device's effectiveness for the future. The Q-2 air mattress system incorporates support and cushion surfaces. An electronic device pumps air into the mattress, and pressure is redistributed upon user needs, the data is digitally captured and documented, and the sensing and redistribution continue- keeping the user consistently comfortable and the staff aware at all times. The Q-2 system provides a greater alternative for pressure ulcer prevention, while being a cost-effective treatment for hospitalized patients.

Amity Regional High School
Deborah Day, Teacher

Vince Li

Project #73

Research Proposal, Engineering, Physical Science

Synthesis and Improvement of Mechanical Robustness Within Photonic Crystals

Photonic crystals are periodic optical nanostructures capable of affecting electromagnetic wave propagation by defining allowed and forbidden bands of wavelengths, allowing them to easily control light. However, practical application would greatly increase if photonic crystals of selective dimensions could be synthesized with more elasticity, rather than their inherent brittle state, thereby increasing its robustness. This would be accomplished through use of self-assembled ABA bottlebrush block copolymers. The A block will be polystyrene, which serves as a hard domain, while the B block would be polydimethylsiloxane, which is softer. The block copolymers will be synthesized via ring opening metathesis polymerization. I expect that the experiment will result in synthesis of mechanically robust photonic crystals. After designing the photonic crystal, it will be tested for elasticity, which we expect to see present in the photonic crystal. Photonic crystals can be used, in theory, wherever light must be manipulated. Current uses include thin-film optics, such as coating on lenses and paints, and photonic crystal fibers, which is applied in many areas, including fiber optics communications. In addition, they are expected to find future use in solar panels and within computers.

Amity Regional High School
Deborah Day, Teacher

Katherine Handler

Project #74

Completed Project, Science, Environmental

The Influence of Wildebeest Carcass Inputs on the Diet of Fish in the Mara River

The Mara River is a vital component in the Serengeti Mara Ecosystem, affected by surrounding terrestrial ecosystems. Wildebeest migrate across the river, resulting in mass drowning events with large inputs of carcasses. This offers an abundant source of organic matter for fish to consume directly or indirectly by stimulating primary and secondary production. The purpose of this research is to determine if wildebeest inputs influence fish diet. I hypothesize that the closer to the wildebeest inputs the fish are, the more alike the gut contents will be to the carcasses. I analyzed the fish gut contents from two sites: 1) above wildlife influence and 2) within the region influenced by wildebeest. Fish collected in field research were stored in ethanol. We removed the gut track, emptied the gut contents onto petri dishes, and analyzed them under microscopes. The data was analyzed in a volumetric method by comparing the percentages of each gut content group. Data is currently still being collected, but results thus far show that the gut contents include leaf and amorphous detritus as well as varying algae and bacteria species. Final results are expected to show that fish collected within the region of carcasses will have more wildebeest carcass particles as well as algae species. The results from this study will help determine additional scavengers of the wildebeest carcasses in the Mara River in addition to determining the path on which nutrients from these input events travel. This is important because it will show the intricate relationship between aquatic and terrestrial ecosystems, highlighting the importance one species can have.

Amity Regional High School
Deborah Day, Teacher

Neha Pashankar

Project #75

Completed Project, Science, Behavioral

Investigating vPFC mGluR5 Availability and Behavioral and Cognitive Difficulties in Individuals with Bipolar Disorder Depression, Major Depressive Disorder, and Healthy Controls

The ventral prefrontal cortex (vPFC) shows dysfunction in Bipolar Disorder (BD) that is consistent with the roles of the vPFC in emotional regulation in patients with BD and Major Depressive Disorder (MDD). There may be an association between the vPFC mGluR5, a receptor in the glutamatergic system, and responses in the vPFC to emotional stimuli and functional connectivity. This study investigates whether dysregulation in vPFC mGluR5 availability subserves the cognitive and mood dysfunction observed in BD Depression (BD-Dep) and whether this differs in Major Depressive Disorder (MDD-Dep) and healthy controls (HC). The independent variable is the groups: MDD-Dep, BD-Dep, HC. The dependent variables are the mGluR5 availability (measured by the volume of tissue (VT) from the PET), functional connectivity and activation (measured by the Ekman Series within the fMRI), and cognitive performance. Participants include 4 patients with BD-Dep, 9 with MDD-Dep, and 13 HC. Participants participated in a comprehensive diagnostic, symptom and cognitive assessment, and a PET and an fMRI scanning session. The interim analysis shows that the HC have the most VT in all three regions of interest in the prefrontal cortex versus the patient groups (BD-Dep and MDD-Dep). The fMRI data is currently being analyzed. Within the cognitive domains, the significant results show that HC perform the best on these tasks as compared to the patient groups. This study could advance understanding of BD pathophysiology, including identification of biomarkers that distinguish BD-Dep and MDD-Dep and mechanisms that could be specifically targeted for more effective treatments for BD-Dep.

Amity Regional High School
Deborah Day, Teacher

Kelsey O'Connor

Project #76

Completed Project, Science, Environmental

Using Octadecanol To Prevent Freshwater Evaporation in Areas of Droughts

One of the largest problems facing areas with droughts is evaporation. Long periods of hot days and warm sun evaporate large bodies of public water supply resulting in a water shortage, major crop death, etc. Octadecanol is an organic compound which is effective at preventing evaporation at rates of up to 80 percent. This allowed for water to continue to evaporate into the atmosphere, but prevents large scale evaporation resulting in water shortages. In a small scale application, water and octadecanol will be placed in a 250 mL beaker. By having differing ratios of octadecanol to water, determined by molar mass converted to grams, in regulated environment with a heat lamp placed over the beaker to simulate the sun, it can be determined if octadecanol has any effect on the rate at which water evaporates and can be used as a viable method for preventing large scale evaporation.

Newtown High School
Tim DeJulio, Teacher

Fallon Torres

Project #77

Research Proposal, Science, Health and Medical

Solving Color Blindness Through Genetic Engineering

Project addresses genetic disorder color blindness and disabling effect it has on those who possess it. 2.7 million people have this color deficiency. I plan to change this in the future through genetic engineering by looking into the possible genetic causes of this and do research on genes, proteins and pathways involved with eyes to help during my experiments to further understand how they work and what I could alter. Experiment difficult to accomplish; warrant would be needed to even attempt to genetically modify small vertebrates, such as mice, if needed. Will perform color experiment using jellyfish. Jellyfish able to sense color of light and react to it depending on what color it is. Experiment be repeated several times and with different species of jellyfish to see if they respond the same way for both species and each individual jellyfish. If jellyfish don't respond to light like their species should, they'll be counted as nonsighted or colorblind. If colorblind will react to some colors and not others, nonsighted if no reaction at all. Gathering data will help me in my research on colorblindness and get someone to shadow so I can gain more knowledge on genetic engineering. If successful, this discovery could decrease amount of colorblind people by many. I hope to gather data that will help me in my research on colorblindness and get someone to shadow so I can gain more knowledge on genetic engineering. If successful, this scientific discovery could decrease amount of colorblind people by many.

Newtown High School
Timothy DeJulio, Teacher

Chris Vernal

Project #78

Research Proposal, Science, Health and Medical

Creation of a Screening Tool for Assessing Baseball Pitching Biomechanics

Improper mechanics in baseball pitching can place increased stress on the arm and shoulder of a pitcher, which can lead to injuries. One of the most common injuries is a tear of the ulnar collateral ligament (UCL) which can sideline a player for at least a full season. Previous studies have identified biomechanical flaws in the pitching motion that place more stress on the arm and may contribute to injury. The goal of this proposed research is to create a reliable system for assessing pitching mechanics and identifying injury risk factors. The Landing Error Scoring System (LESS) is a screening tool used to assess jump-landing biomechanics in relation to anterior cruciate ligament (ACL) injury risk. LESS consists of 17 definitions of error, with one point being awarded when error is present. Higher scores correlate with greater injury risk. A similar system with at least 10 definitions of error can be adapted for evaluating baseball pitching mechanics and injury risk factors. This proposed study will show if such a system is feasible, or if the pitching motion is too fast and complex to be evaluated in this form. This system, if successful, will allow coaches to evaluate different pitching motions with a single, standard test. Pitchers who score higher will have an increased risk for injury. Previous studies have focused on using three-dimensional motion analysis or computer simulations to evaluate pitching motions. However, this proposed research will provide coaches with a simple and effective tool to evaluate pitching mechanics at any time. This is especially useful in a live-game setting as pitchers become fatigued and are more prone to a breakdown in their mechanics and potential injury.

Darien High School
Christine Leventhal, Teacher

Lily Kosnik

Project #79

Research Proposal, Science, Environmental

The Effect of Increased Sea Temperature on the Progression of Black Band Disease of *Siderastrea Siderea*

Climate change has resulted in greater stress on coral reefs world-wide. This stress has resulted in coral bleaching, but has also affected the occurrence of coral diseases such as Black Band disease (BBD). BBD is characterized by a 1mm to 1cm wide band, a microbial mat, that separates areas of living tissue and exposed skeleton. The correlation between the occurrence of BBD and elevated temperatures is likely caused by the microbial mat being dominated by cyanobacteria, which have an optimal photosynthetic rate at higher temperatures. When affected by stressors like elevated temperature, corals also become increasingly susceptible to disease. The proposed research aims to discover if an increase in sea temperature will correlate with a more rapid progression of the disease in the coral *Siderastrea siderea*. Three areas measuring 1m² in Greater Lameshur Bay, St. John, USVI will be marked at intervals of 5m at a depth of 2.0-3.0 m. Within each sample area the percent cover of coral with lesions will be determined by the quadrat method. Locations of all known corals infected with BBD will be mapped prior to the experiment. The number of newly infected corals per week, from June to August, in contact with infected corals will be mapped and used to determine progression of black band disease in each month. It is expected that in the summer months, higher average temperatures will cause an increase in tissue affected by BBD. Knowing these results will lead to a better understanding of environmental parameters effects on disease abundance in the coral *Siderastrea siderea*.

Darien High School
Guy Pratt, Teacher

Scott Barnett

Project #80

Research Proposal, Engineering, Health and Medical

Smart Bandage Development for Chronic Wound Ulcers

Smart Bandage Development for Chronic Wound Ulcers. A wireless connected Smart Bandage to detect early signs of infection in chronic venous leg ulcers. Included in the bandage are sensors for swelling and moisture. Methods: test fractal wiring, test swelling methods Fractal wiring proved to be accurate to 5mOhms and Swelling accurate to 5cm Patients and doctors will be able to know early warning signs of an infection of their chronic wounds.

Greens Farm Academy
Mathieu Freeman, Teacher

Madison Day Bridget Murphy

Project #81

Research Proposal, Science, Environmental

Tracking the Abundance of *Odocoileus virginianus* (White-Tailed Deer) to Determine the Effectiveness of a Deer Management Program Designed to Preserve the Old-growth Eastern Hemlock *Tsuga canadensis* Forest at the Mianus River Gorge Preserve

Research involving the deer population at the Mianus River Gorge Preserve (MRGP) has been conducted since 1965, when the first survey of the land was conducted. In addition, it was found that between 1965 and 2004, as the white-tailed deer became overpopulated, the old-growth eastern hemlock *Tsuga canadensis* forest was affected, causing the soil to not properly filter the area's water supply. In hopes of reducing the overpopulation of deer, the Mianus River Gorge Preserve has instituted a deer hunting program within the Gorge. The purpose of this project is to see whether there has been a decrease in the deer population since 2007 that ultimately would reverse the effects of deer overpopulation on native plants. It is hypothesized that since 2007, the deer population has significantly decreased. To track deer population, unbaited cameras, triggered by heat and motion to take five successive photos at a time, were placed at 14 specific locations throughout the MRGP each year between 2007 and 2016. For accuracy of events, photos were taken at a rate of one photograph per second, almost continuously. These photos were analyzed and events of animals were recorded. Events including the branch-antlered bucks were organized separately, and an estimate of bucks, spikes, does, and fawns were calculated based on the data for each year. It is expected that once the data analysis has been completed, there will be a significant reduction in the deer population from 2007 to the present. Further research will be conducted at the MRGP involving both deer behavior and the behavior of other mammals, such as coyotes, because overpopulation of a species can disrupt the balance of an ecosystem.

Convent of the Sacred Heart
Mary Musolino, Teacher

Ningxin Luo

Project #82

Research Proposal, Science, Behavioral

Effect of Positive Moods Compared to Negative Moods on Preference of Pictures

Positive and negative mood inductions have often been hypothesized to affect behavioral changes in adolescents. This experiment is investigating whether a positive mood induction compared to a negative mood induction will affect an individual's preference on a certain picture. These pictures will be categorized as positive or negative based on how the item or action that is demonstrated would affect a person's mental and physical health. The undeveloped prefrontal cortex in adolescents, which is responsible for abstract reasoning and judgment, often results in sudden decisions. Studies have also supported that mood is a motivator for daily, automatic behaviors which may affect a participant's instinctive preferences. It is hypothesized that if a positive mood induction is given, then a positive picture will be preferred; if a negative induction is given, then a negative picture will be preferred. . In this experiment, pictures will be depicting social situations/interactions, clean/un-clean environments, and pleasant/unpleasant items. Several individuals will be randomly assigned to either a positive mood induction, negative mood induction, or no induction. The participants will be asked to write down their experience during a 15 minute period. Questions such as who was present and what happened will make the individuals relive their experiences as realistically as possible. A series of one positive and one negative picture will be presented in front of the individuals. They will be asked to choose instinctively between picture A or B under the limited time span of 3 seconds. The results will be compared between the positive mood induction and the negative mood induction. They will be based on the average preference of picture per group.

Amity Regional High School
Catherine Piscitelli, Teacher

Caroline Finn

Project #83

Research Proposal, Engineering, Physical Science

Reinforcing Silica-Based Aerogels with Carbon Nanotubes to Improve Strength and Insulating Capacity

The purpose of this study is to determine the impact that double- and triple-walled carbon nanotubes can make on the strength and insulating capacity of silica-based aerogels. Studies have been conducted that measure the impact that single-walled carbon nanotubes can make on silica-based aerogels, but not double- and triple-walled. These new carbon nanotube-reinforced aerogels will be made and tested according to existing protocol. This new and improved aerogel will be used for insulation purposes and will be a better alternative to silica-based aerogels because of the decreased density and increased strength and insulation capabilities.

Convent of the Sacred Heart
Mary Musolino, Teacher

Sean Lee

Project #84

Research Proposal, Science, Physical Science

The Effect of Battery Percentage on Wifi Performance

Laptops are used in many different ways ranging from school, to work, or just simply downtime, but most of these activities require a strong wifi connection for the best user experience. However, laptops aren't perfect; all laptops have a battery that needs to be charged regularly which creates a new variable to finishing computer-related work over a long period of time. This experiment will be testing, "How does percentage of battery lasting on a computer affects wifi performance?" The independent variable will be varying types of battery percentages. The dependent variables will be the download speed, upload speed, and ping of the wifi. It is hypothesized that if the battery percentage on a computer is at 5% or below, then the wifi will be slower. A Macbook Pro will be used and it will be at 100% for the first five trials and be tested to using a wifi statistics test website and the results from each website will be averaged to find the average speed. The same thing will be done for the battery percentages 50% and 5% with five trials each percentage tested. There will be no control for this experiment. Data will be collected from a wifi speed test website (<http://www.speedtest.net>) that finds wifi statistics three separate times and the results will be averaged into a final result. This conclusion can be used to help people that have laptops as a big part in their life to know when they should start charging up, so that work can be done faster and more efficiently.

Amity Regional High School
Scott Demeo, Teacher

Sophia Wang

Project #85

Research Proposal, Engineering, Environmental

The Early Detection of Sinkholes

Sensors and designs derived from the structural health monitoring system will be used to better detect underground cavities in areas where sinkholes are common. Currently, the only detection technique is by interferometric synthetic aperture radar (InSAR). These techniques are costly and inefficient. In the United States of America, 20% of all land is susceptible to sinkholes. These cavities are capable of "swallowing" cars, infrastructures, and unsuspecting individuals. To undergo this project, various elements must be considered. In order to identify a sinkhole, data from sensors can be analyzed to find regular and irregular patterns, therefore recognizing cavities. This sensor system will be used on roadways since there is constant movement and therefore constant detection. A constant weight will be moved across the modeled road. These designs can be applied in many areas, and thus, sensors must be tested at different locations to determine the most effective location. To test this, a sinkhole model will be built in an empty aquarium. This aquarium will have limestone, clay, groundwater, and surface soil. The sinkhole will be modeled evenly throughout the road. There will be five experimental groups to test which area sensors would best detect sinkholes. The independent variable tested will be the location on the road. The dependent variable will be the margin of error compared to the model detection pattern. The data will then be analyzed to identify the most effective location. Designs derived from the structural health monitoring system can be applied to these sensors so the results can be viewed via wireless connection.. This system is used in bridges and concrete to identify cracks and areas of stress. These designs can identify cavities and save lives.

Amity Regional High School
Scott DeMeo, Teacher

Natalie Prinz

Project #86

Individual Project, Science, Behavioral

The Effects of Smell on Attention and Short Term Memory

Smell has been shown to affect attention and memory; specifically, peppermint has been shown to enhance alertness and performance. This experiment will examine if the smell of vanilla, cinnamon, and lavender have effects on short term memory and attention in teens. The independent variable will be the type of smell- vanilla, cinnamon, and lavender essential oil. The dependent variable will be the results of the memory and attention tests. The hypothesis of this experiment is that the smell cinnamon will result in better attention and short term memory in teens because it is already proven in past experiments that the smell of cinnamon increases alertness and serves as a central nervous system stimulant. Each group of participants will take the Stroop Color-word interference test and short term memory test before smelling the scent to see how well their attention and memory already is. Then, after smelling the specific scent, they will take different versions of those same tests. The control for this experiment will be a group of participants who smell a cotton ball with no scent before taking the second version of the tests. The difference between the two averages of each group's scores will determine if the smells have an affect on short term memory or attentiveness compared to the control of no scent smelled. This conclusion will help researchers decide what smell car fresheners should be so people will have better attention when driving. This could decrease the number of accidents and therefore the number of deaths when driving. The conclusion from this experiment will also help researchers decide if certain smells should be distributed throughout classrooms or offices where short term memory and attention is used.

Amity Regional High School
Scott DeMeo, Teacher

Ariba Chaudhry

Project #87

Research Proposal, Science, Behavioral

The Effect of the Vibrancy of Colored Paper on Test Scores

Color has been shown to affect mood and productivity in a variety of different situations. Oftentimes, teachers print tests on different colored paper. Recently, it has been found that many students perform better on tests on blue paper than white paper. This study will be examining which vibrancy of blue paper results in the highest test scores. Vibrancy is being defined as perceived luminance. The independent variable will be the vibrancy of the test paper. This will be found by scanning the papers to get the RGB values of the paper and then inputting the values into the formula for perceived luminance. The dependent variable will be the performance on the test. The control group will be a test on plain white paper. It is hypothesized that brighter versions of the color will have a negative effect on test performance. Tests will be taken on 5 different shades of blue paper. The tests will not be about a specific subject, but about patterns and analogies, so that skill level in a certain subject is not a variable. All of the tests will be the same. It is hypothesized that brighter versions of a color will have a negative effect on test performance. Tests will be taken on 5 different shades of blue paper. The tests will not be about a specific subject, but about patterns and analogies, so that skill level in a certain subject is not a variable. All of the tests will be the same.

Amity Regional High School
Scott DeMeo, Teacher

David Sugarmann

Project #88

Research Proposal, Science, Physical Science

The Effect of Shock Absorbers on the Speed of Tennis Balls

It has been proven that using a shock absorber will reduce the vibration levels. The question that this study will answer is, "How does the amount of shock absorbers on a tennis racket affect the speed it hits a tennis ball?" It is hypothesized that having more shock absorbers on a tennis racket will cause an increase in ball speed and having less shock absorbers will decrease the ball speed. The independent variable is the amount of shock absorbers on the tennis racket. The dependent variable is the speed of the tennis ball after it hits the racket. Constants include the location the ball is dropped from, the tennis ball and racket used, the type of shock absorbers, and the timing method. Each trial will be recorded in slow motion to see when the ball gets to its highest point. A meter stick will be used in order to accurately measure the height. The control group that will be tested will have no shock absorbers on the racket. The second group will have one shock absorber put in between the two center vertical strings directly below the bottom horizontal string. A third group will have two more shock absorbers placed directly next to the one already there. For the last group, the center shock absorber will be taken off of the racket. After all of the results are collected, each individual speed will be found by dividing the highest height of the ball reaches by the time it takes to get to that height. When this is completed, the average speed of each group will be calculated. These results will then be analyzed for statistical significance.

Amity Regional High School
Scott DeMeo, Teacher

Rhea Dey

Project #89

Research Proposal, Science, Behavioral

Memory Recall In Different Age Groups Using an Olfactory Stimulation

Smells pass through the nose and stimulate the hippocampus and amygdala, two regions of the brain that are associated with memory formation and recall. Interestingly, studies have shown that smells from nature are best for stimulating memory recall. A smell that mimics the scent of nature is the Balsam and Cedar Yankee Candle. The experiment proposed will test how information recall is affected by re-exposure to a scent a person is exposed to while learning that information, and how this effect varies between the age groups 10-30, 31-60, and 61-80. It is hypothesized that the individuals aging 10-30 who are exposed to Balsam and Cedar while learning and recalling will score higher on the working memory performance test than those who are not. The independent variable is whether or not subjects are exposed to a smell during information learning and recall. The dependent variable is the score of the working memory performance test which involves subjects learning a series of ten numbers and letters and then having to recall them shortly after. There will be a total of 14 people in each age group, and 7 subjects will be assigned to each age group for the control and experimental group. The subject will smell the candle if they are in the experimental group or will not if they are in the control group while looking at a series of number and letters for 60 seconds. Then, after five minutes, they will smell the candle again if they were given one and recite these numbers and letters. The results will be examined to see which age group scored the highest and whether smell had enhanced their memory.

Amity Regional High School
Scott DeMeo, Teacher

Raymond Lu

Project #90

Research Proposal, Science, Behavioral

The Peltzman Effect and its Role in Academic Integrity

Cheating on tests has become a widespread problem throughout schools all over the nation. Studies have found that about 95% of high school students have admitted to participating in some sort of academic cheating. Plagiarism and copying are problems that can sometimes lead to expulsion. The Peltzman effect is a theory that states when safety regulations are put in place, people tend to increase risky behavior. This experiment will find if the Peltzman effect causes students to take more risks and cheat in school. The independent variable will be the application of cheating limiting rules and regulations- mixed up test forms, varied colors. The dependent variable will be the amount of cheating admitted, found through an anonymous survey. It is hypothesized that because of the Peltzman effect, subjects exposed to regulations preventing cheating will be more inclined to cheat. If there are "safety measures" against cheating, students may have an urge to cheat. Also, they may feel inclined to test the limits and check the restrictions. One experimental group will have a group of students with different test forms and different questions. A second group will have subjects with only different color tests. The control group will have students all take the exact same test, with no cheating limitations. Fifteen different subjects per group, that are all freshman in high school, will be situated right next to each other in desks. A teacher will give them a short test with straightforward multiple choice answers. The tests will be taken for 10 minutes and designed to be challenging, trivial questions. There will also be a \$15 iTunes gift card reward for the subject that scores the highest on the test.

Amity Regional High School
Scott DeMeo, Teacher

Michael Lebreck

Project #91

Research Proposal, Science, Environmental

The effect of water salinity on the growth rate of Brine Shrimp

Knowing all the variables that affect fish in the ocean is important for it can narrow down the causes of population decline. One factor that changes depending on location is the salinity in water. The independent variable is the concentration of salt or salinity, with the maximum concentration still being a safe level for the Brine Shrimp. The dependent variable is the growth rate of the fish. For fish to survive in salt-water, they need to be constantly regulating the salt in their body compared to the salt concentration of the water and the kidneys are tasked with this process. There will be three experimental groups testing different salinities. One will be the control, with the salinity being the normal salinity for the Brine Shrimp, which is approximately 35 parts per thousand or 3.5% salinity. The second group will have an increased salinity of 4% and the last group will have an increased salinity of 3%. The maximum salinity is still found in nature with the Brine Shrimp living and thriving in it along with the lowest salinity. The groups will be observed every three days to monitor their growth. The growth will be measured by the increase in mass and volume. The volume will be measured by water displacement and the difference in masses. The growth will be measured by the increase in mass and volume, which will be measured by water displacement. The conclusion of this experiment will find if there is a relationship between salinity and growth rate of fish. This will then be used as a reason for why fish populations are declining or going locally extinct at certain locations.

Amity Regional High School
Scott DeMeo, Teacher

Tracy Lu

Project #92

Research Proposal, Science, Behavioral

Font Color And Memory

Finding ways to easily memorize information is useful in many ways, and studies have shown that color has an effect on memory. In this study, it will be tested if font color impacts a freshman in high school's ability to remember information. It is hypothesized that if color of font effects memory, then information presented in warmer colors, like red, will be more memorable. Past studies have shown that people remembered more information when paper was a warm color, and remembered warmer colors better. The independent variable is color of font. The dependent variable is how well the subjects remember the information, which will be measured by the subjects take a test containing multiple choice questions. The control will read text in black font, and the experimental colors will be red, green, and blue. The test environment, paper color, age of subjects, time allotted for the test, material read, and test questions will all be held constant. The subjects will be given ten minutes to read a fictional story created by the researcher, so that no subjects will have prior knowledge. Everyone will read part of text in black, and another portion in a color. After ten minutes, they will be given the test. Data will be gathered about their score on the questions about the black text versus on the colored text. This method eliminates the factor that some people have better memory than others, because each subject is being compared to themselves. A difference in score on the two parts will be recorded to find a group average.

Amity Regional High School
Scott DeMeo, Teacher

Jay Moon

Project #93

Research Proposal, Science, Behavioral

The Effect of Positive and Negative Reinforcement on Quiz Results

Positive feedback from coaches has been scientifically proven to improve high school athletes' performance due to player encouragement. Other studies have shown that depressed moods detrimentally affect students' academics. Such moods created feelings of helplessness, taking away students' willingness to learn. This relates to the Placebo Effect, which is when a participant's health or behavior changes due to expectations. Differing types of reinforcements after a quiz may affect the results of the following quiz, as it leads students to believe that is how they will perform. This experiment will examine the effects of positive and negative reinforcement after the first quiz on the performance on a second quiz. The independent variable is the type of reinforcement given. The dependent variable is the result of the second quiz in comparison to the first one. The control group not be given any reinforcement. It is hypothesized that if students are given positive reinforcement, then they will experience greater increases in results between the two quizzes. Both quizzes will consist of practice SAT writing and language questions. All participants will be given quizzes, and then be told that they performed badly right after. One group will then be given positive feedback, another given negative feedback, and the third will not receive anything. The participants will then take the second quiz. For analysis, results of both assessments will be compared in order to determine the change in each individual's results. The results will show which reinforcement type causes the largest performance increase, which will cause students to perform better during testing. This may motivate instructors to offer this type of reinforcement before or after the students take an assessment in their classes.

Amity Regional High School
Scott DeMeo, Teacher

Ella Marin

Project #94

Research Proposal, Science, Behavioral

The Effectiveness of the Memory Palace Technique in Adolescents

Students in high school have been burdened with having to memorize information. Many students are ignorant of memorization techniques. Written Repetition (WR) is simply writing information continuously in order to commit it to memory. Professional memory athletes use an ancient technique that involves using the brain's natural ability to memorize information in notable images placed in familiar surroundings. It is called the Memory Palace Technique (MPT). This research project will answer the question, is the MPT a more effective way to memorize information than WR in high school freshmen? It is hypothesized that when students undergo brief training in MPT, it will be a more effective way to memorize information than WR. The independent variable is the memorization technique while the dependent variable is the accuracy of the memorized material. There will be a control and experimental group each containing fifteen students. Each group will undergo two rounds of memory testing. In Round 1, which will be a baseline for all participants, each group will be given a random set of fifteen pictures of objects which they will be asked to memorize in five minutes using WR. After twenty minutes, the students will be asked to write the order of the objects. The accuracy will be scored. In Round 2, Group 1 will again use WR while Group 2 will be asked to memorize their objects using MPT after undergoing brief training in the technique. The improvement in both groups will be compared to see if MPT training improves memory relative to WR. If the MPT does prove to work in high school freshmen, then this experiment could help students in the future memorize material with higher accuracy.

Amity Regional High School
Scott DeMeo, Teacher

Evan Hollander

Project #95

Research Proposal, Science, Behavioral

The Effect of Humor Use in Advertisements on the Perceived Quality of the Company Advertised

Humor has long been used in advertisements as a method of making the ads easier to remember. Examples range from Super Bowl commercials to highway billboards to magazine print ads. However, it is unknown what effect this technique has on how consumers perceive the product or service advertised. This study will evaluate the effects of humor on the perceived quality of the product or service. 12 ads are gathered online, all of which are meant for high schoolers. 2 print ads are for each company; 1 is funny, and 1 is not funny. Both groups view 3 funny and 3 not funny ads. A link that leads to the survey will be emailed. A second link will be provided when the participants finish. The second survey will ask participants to mark the ads funny or not. Ad order will be randomized per participant. Participants will read quick instructions on what they will do (they will not know they are focusing on humor). Participants are aged 14-18. Participants will complete online surveys to evaluate companies. Participants will complete the survey between 2:00 PM and 5:00 PM. Companies are rated on quality. Ratings are averaged in categories. These results can help advertising firms better design ads.

Amity Regional High School
Scott DeMeo, Teacher

Katie Barretta**Project #96**

Research Proposal, Science, Health and Medical

Effect of Type-One Diabetics' Taste Detection on Artificial Sweeteners and Pure Cane Sugar

Type-One Diabetics are required to be cautious of the amount of carbohydrates consumed. Diabetes revolves around food and its components of carbohydrates. When carbohydrates are absorbed, it is broken down into sugar. The question posed was if Type-One Diabetics possess a sugar sensitivity. It can be hypothesized that if Type-One Diabetics taste small samples of the foods and substances, each made with a pure or synthetic sugar. This experiment will investigate the effects of Type-One Diabetics ability to detect artificial sweeteners and pure cane sugar. The study will determine if the sense, taste, is magnified of a Type-One Diabetic. It will be investigated if Juvenile Diabetics achieve a more defined sense of taste; since the disease correlates with glucose and food. Prior to the experiment, subjects involved in the study will be required to fill out a questionnaire asking what types of experience the subject has had with certain sweeteners. The independent variable will be recognized as the pure cane sugar and artificial sweeteners. The sweeteners will be added into sugar based foods and substances. The dependent variable will be the taste detected differences between the sweeteners. Food and drinks containing sugar will be tested by Diabetics to view the effect of their determination of what was kind of sweetener the substance involves. Non diabetics, the control, will complete the same task to compare if taste is magnified in those affected by the disease. In between food samples, the subjects will be given a cracker and water, which will act as a palate cleanser. These results will show if type one diabetics have a magnified sense of taste towards sugar, which plays a component in the disease.

Amity Regional High School
Scott DeMeo, Teacher

Jack Tajmajer**Project #97**

Research Proposal, Science, Behavioral

The Reactions of Various Ages to Visual Subconscious Stimuli

In this study, data will be collected to see if people of various ages in high school react differently to visual subconscious stimuli. It is hypothesized that if visual subconscious stimuli is shown to high schoolers of different age groups, then the younger age groups will be attracted to the warmer colors and will choose the image corresponding with the subconscious stimuli more than the older age groups. The independent variable is the ages of the participants, with ages between thirteen and nineteen. The dependent variable is the reactions of the participants, which will be measured with the averaged results of a personally designed survey. This will ask the participants to choose between two identical images shown side by side after viewing a positive or negative scene. There's no control group because there's no general age or response. There are four experimental groups of different ages. Ten participants from different class levels will be in each group for the intelligence factor and tested for color blindness. Each group will have time to test, and, daily, five participants will go into the same room and sit at a computer. They will see a "positive" or "negative" image, and choose between images with warmer or cooler colors on the survey. There will be fifty images shown to choose and twenty five images projecting the stimuli. This will be repeated for each experimental group. After the groups are finished, the average results for each group will be calculated by finding the most common choices, as well as if the subliminal stimuli had a large effect. If there is no average for a group, the similarities between the choices will be compared.

Amity Regional High School
Scott DeMeo, Teacher

Rosie Du
Courtney Greifenberger **Project #98**

Completed Project, Engineering, Physical Science

The Effect of Bio-Inspired Textures on Friction

Humans often look to nature for inspiration in solving technological problems through biomimicry. A research study analyzing organisms' adhesion mechanisms motivated the research question: How do bio-inspired patterns on a large scale impact friction? The independent variable is the surface design/pattern. The dependent variable is the amount of friction (Newtons). Designs (small mushroom shaped pillars mimicking gecko setae, indentations like wet human hands, hooks mimicking galium aparine, cone structures like canine paws) were modeled in CAD and printed onto rubber coated silicone panels (110x60x4mm). The control has a flat surface and same dimensions and material as other designs. Each design was tested by dragging against different surfaces using a piezoelectric force sensor to measure frictional resistance. It was hypothesized that change in surface design would result in a rise of friction. Results supported the hypothesis. The designs which increase friction the most were the pillars mimicking gecko setae and human hand indentations. Results showed friction for the control and designs was considerably higher when on the dry surface. All trials displayed the magnitude of static friction being greater than kinetic friction. Because the designs were large scale, data showed that bio-inspired designs impacted friction greatly. The p-values between each design and the control were both less than .001. There are many implications to increasing and decreasing friction, including increasing the resistance of a tire tread, or optimizing efficiency on a conveyer belts' durability. These designs could be implemented in hiking boots to optimize durability.

Amity Regional High School
Deborah Day, Teacher

Daniel Pfrommer **Project #99**

Completed Project, Science, Physical Science

AprilTrack: A Particle-Filter based AprilTag Tracker

The AprilTrack algorithm proposed and used in this experiment seeks to bridge two existing fields of research in computer vision literature: visual fiducial (or simply fiducial) detection and monocular object tracking. With a rise in the popularity of fiducials, or artificial markers, as a source of ground-truth position data for mobile robots, there has been a considerable interest in designing robust and blur-resistant fiducials. Rather than devising an entirely new marker as others have in the past, the AprilTrack algorithm attempts to improve on existing fiducials, such as the popular AprilTag marker, by augmenting fiducial detection algorithms with a particle-filter based monocular object tracker which reliably tracks both a fiducial's position and orientation (i.e six degrees of freedom), allowing for tag-based localization in situations where still-frame-based methods would be unable to do so. This is accomplished by discretely approximating the probability distribution of possible tag poses given a sequence of input images as a set of particles which are updated each iteration (each time a new image is processed) with a SIR particle filter. The AprilTrack algorithm is also extended in this experiment to simultaneously and accurately track multiple tags, allowing for the use of the AprilTrack algorithm in more complex scenarios. The algorithm was evaluated on several sequences and was compared to a hand-labeled ground truth, demonstrating that it is capable of providing ground-truth position data for evaluating performance on visual odometry datasets and allowing for the accurate tracking of blurred tags in high-motion scenarios with poor illumination.

Darien High School
David Lewis, Teacher

Nevia Selmon

Project #100

Completed Project, Science, Environmental

Feline Integration with Technology

Technology is advancing at an exponential rate, continually improving with new adaptations to better equipment and increase efficiency. Animal integration with technology has recently surfaced due to the variety of benefits that technology has brought to humans. This experiment will study the interaction between a cat and a robot, in an attempt to better understand animal cognition. The independent variable was the robot and the added accessories, a feather and a laser. The dependent variable was the cat's reaction towards the robot and the different accessories, as well as the amount of time the cat interacts with the robot in the 5-minute time period. The control was the trial with solely the robot, and no added accessories. This experiment took place at the Bethany Animal Hospital under the supervision of Dr. Jackson and associates. It was hypothesized that the cat will have the most interactions with the robot and attached feather. Data thus far shows that cats show the most interest in the robot with the attached laser. Making strides and advancements in the field of animal integration with technology can improve the relationship between humans and their animal counterparts, due to new insights in the mood, emotional wellbeing, and manner of play. As technology continues to improve, pet owners will be able to pick up their mobile device whenever they are out of the house and start interacting with their pet through the robot that inhabits their home, providing interaction with the pet throughout the day.

Amity Regional High School
Deborah Day, Teacher

Himay Dharani

Kelsey McCormack

Project #101

Completed Project, Science, Physical Science

Analysis and Proving of "Cycloid" Universe Using Friedmann Equations and Torsion Cosmology

The Big Bang theory describes the universe as an expansion from a single point. However, taking into account the theoretical mechanic of torsion, these infinite densities, found in the moments before the Big Bang and in celestial bodies such as black holes, can not exist. Thus, torsion cosmology hypothesizes that the universe contracts and expands cyclically, its scale factor being represented using a cycloid graph. To do this we are looking at manipulating the Friedmann equations, which express the expansion of the universe in relation to multiple variables. We will be setting the parameters for a non-relativistic universe, meaning one that is without pressure or a "cold" universe, and derive parametric functions to prove that the universe is continually expanding and contracting, modeling the hypothetical cycloid growth of the universe. The derived equations should model a value for scale factor, denoted as a , which can be conceptualized as the radius of a four-dimensional "sphere", and it should model this with respect to time. The change in a with respect to time should determine whether the universe is expanding or contracting, and the change in this change with respect to time will determine whether it is accelerating or decelerating. By understanding and proving that the universe's expansions and contractions are cyclical and contingent on mass and potential energy at each contraction, it can be determined as to which bounce we are currently in. Going off of this information, it can be subsequently determined whether the universe will continue to expand towards total entropy or contract once again. It will lend credence to the "bubble-universe" theory occurring in black holes.

Amity Regional High School
Deborah Day, Teacher

Aniruddha Murali
Zachary De Brino

Project #102

Research Proposal, Science, Environmental

The Effect of Different Catalysts on the Conversion of Carbon Dioxide to Methanol

Climate change, and decrease in the supply of energy are two major issues in today's society. The warming of the environment by greenhouse gases such as carbon dioxide is negatively impacting the environment, and there are currently no defined solutions that return a large supply of energy without harming the environment. There is currently research on converting carbon dioxide to fuel. In this experiment, six catalysts (silicon, cobalt, copper, iron, nickel, and zinc) are tested to see which catalyst yields the highest rate of reaction when converting carbon dioxide to methanol. Electrolysis will be used to produce hydrogen gas to activate the reaction of $\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_3\text{OH} + \text{H}_2\text{O}$. Distillation will be used to separate the methanol from the water at the end of each trial. All catalysts used in this experiment have nearly the same electronegativity. Electronegativity of elements does not have to be involved in direct chemical reactions; it is just an atom's ability to pull electrons closer to itself. So, there will be a null hypothesis; it is expected that the type of element in the catalyst will not impact the amount of methanol produced. The data gained from the experiment will show which catalyst works the best to produce the most amount of methanol. The possible next steps for this experiment is that for whatever catalyst works best, that catalyst could be used to determine the optimal amount of the catalyst that will yield the most amount of methanol. Catalysts could also be tested based on a specific property (ex. conductivity, electronegativity) of the best catalyst in this experiment.

Staples High School
Karen Thompson, Teacher

Connor Percarpio

Project #103

Research Proposal, Science, Environmental

Effect of Birthplace on Loggerhead Sea Turtle (Caretta caretta) "Lost Years"

When a marine turtle is born, its natural instinct is to crawl towards the light of the sun or moon reflecting off of the ocean. Little is known about next stage in the turtle's life- it is called the "lost years". Many turtles spend this time drifting across the ocean current with a large patch of macroalgae. Others create their own unique migration pattern, but the determination of how they spend this time is unknown. Researchers today are constantly finding new information on what happens in these juvenile years and why. This experiment will focus on the relation between where the turtle is born and how it migrates. Loggerhead Sea Turtles nests are found off the coasts of six different continents, and many factors can impact how they crawl from their nest to the water: environment, human interaction, pollution, and light pollution (artificial light). These factors affect the turtle's journey to the water and their survival rate. The turtles will be GPS tracked by tags that are secured with acrylic lacquer. The turtles being tracked will be only a few months old (due to the inability of tracking the youngest of hatchlings). The results will be carefully examined to see if there is a correlation between the turtle's birthplace and its migration. It is expected that the turtles who live in areas with less human interaction will move more independently. This is because sea turtles that live in extremely active environments tend to drift with the ocean current rather than control their own migration. The *Caretta caretta* was placed on the endangered species list in 2013, and learning all we can about these turtles could help us save them.

Darien High School
David Lewis, Teacher

Juliana Hopper

Project #104

Research Proposal, Science, Environmental

The Effect of EsMCsu1, from Eutrema Salsugineum, on Transformed Arabidopsis Related to Drought Resistance

Due to the growing drought problem in California, it would be advantageous to transform crops to be drought resistant. This would aid in maintaining enough water to support California's large agricultural community. Arabidopsis, a model organism, can be transformed using the Eutrema Salgeium gene, EsMCsu1, allowing it to go through more ABA synthesis, which closes the stomata, keeping water from transpiring through the leaves, thus conserving water for future use. Transforming the arabidopsis can be achieved through a simplified agrobacterium transfer process(Weeks et. al. 2008). When the Arabidopsis plants, transformed and wild type, reach 10% bloom the water use efficiency (WUE) will be measured through the rate of photosynthesis compared to the amount of water the plant received in the past 48 hours over the rate of photosynthesis per unit of time. Based on the success of a similar experiment transforming the crop alfalfa with the EsMCsu1 gene caused a significant increase in ABA content, so if Arabidopsis is transformed with the same gene ABA content should increase as well causing the plant to be more resistant to drought. Since Arabidopsis is a model organism, the success of this transformation would be beneficial for farmers and water conservation efforts in the future because it could lead to all crops having the ability to use water more efficiently.

Staples High School
Karen Thompson, Teacher

Claire Borecki

Project #105

Completed Project, Science, Behavioral

Least Positive Outcome: Health Service Use in a Longitudinal Study of Autism Spectrum Disorders

Autism is a neurodevelopmental disorder defined by sociocommunication deficits and repetitive behaviors. Young adults with autism have higher incidences of psychotropic medications, seizures, hospitalizations, health service dissatisfaction, and service limitations. Some people within this longitudinal study of autism have had a "very positive outcome," or lost their diagnosis with age. This outcome and predictors of this group have been studied. However, a "least positive outcome" in this study is undefined. This study was conducted at the Center for Autism and the Developing Brain within a 24-year currently ongoing longitudinal study of over 100 participants. Participant parents completed surveys about the participant's health. The data points were counted for frequency within the longitudinal group. Only 4 participants had a psychologist/psychiatrist/neurologist in primary care despite high medication reporting. Care satisfaction was low, although few reported limits on services, implying that the highest area of need is within services themselves. The most reported limit was behavior. A major focus was on small percentages of participants who had extremely high medication use, seizures, no primary care, hospitalizations and behavioral issues. Almost all participants with no primary care had no autism services, a sign of total disengagement. More analyses are being run to look at the overlaps of these groups in an attempt to determine a "least positive outcome" group based on health. Defining this group would allow examination of the factors that contribute to a negative outcome in adulthood, as the childhood data of this group can be examined retrospectively due to the nature of the longitudinal study. This would allow provision of better intervention to avoid such a "least positive outcome".

Darien High School
David Lewis, Teacher

Implementation of Targeted Stretching to Minimize Change in Range of Motion in Game-Like Scenarios and Full Season Play

Baseball is dubbed “America’s Pastime” because the sport is played at all levels around the world, but injury as a result of repetitive throwing has become more prevalent in the past years, severely affecting the careers and health of youth and professional pitchers. Stretching has been proven to improve elasticity and flexibility in the muscles and tendons of the arm. Thus, if short, targeted stretching drills are implemented in game replicated scenarios and, subsequently, in games over the course of a season, then the drills will result in significantly lower changes in range of motion (ROM) compared with pre-throwing values. This occurs because stretching counteracts the tightening of the shoulder and arm that leads to increased risk of microtraumas. The stretching drills will require only 1-2 minutes of a pitcher’s time and will be performed after pitching a bullpen session/inning. Measurements will be taken at three points: before throwing, after throwing, and after stretching. Additionally, the stretching will be implemented in pitchers over the course of the season with measurement collection at its conclusion. From this data, the effectiveness of stretching during the time a pitcher is resting can be determined and applied to injury prevention. The data is expected to show ROM values that are closer to pre-throwing values with the stretching implemented. The data will be analyzed using ANOVA and t tests to find significance, while pre- and post-throwing data can be compared. This experiment would be a step towards finding ways to combat arm injury in baseball players in a noninvasive fashion, and may lead to more studies focused on optimizing stretching routines and preventing injury in baseball players.

Darien High School
David Lewis, Teacher

Genistein and the Enhancement of Chemotherapy against Colorectal Cancer Cells by Inhibition of NF- κ B

Colorectal cancer (CRC) is one of the leading causes of death in adults, and the third most common cancer globally. 50% of CRC patients will develop recurrent disease, indicating the need for improved cancer therapies. One common chemotherapeutic agent used against CRC is 5-Fluorouracil (5-FU). While 5-FU is effective in some patients, it’s rather ineffective in patients with CRC due to acquired progressive resistance of CRC cells to 5-FU. The transcription factor nuclear factor- κ B (NF- κ B) are activated by most tumors, while natural chemopreventive agents suppress it, like genistein. Genistein is commonly found in soy and inhibits NF- κ B in tumor cells to prevent the proliferation of CRC cells. Chemotherapy agents that induce apoptosis also activate NF- κ B, which moderate resistance to chemotherapy drugs in CRC cells. This proposed research will examine the effectiveness of a combination treatment of 5-FU and genistein in a pair of isogenic cell lines, HCT116 and HCT116+ch3. It is hypothesized that genistein will prevent proliferation effects of 5-FU and inhibit the activation of NF- κ B. Cells will be cultured and incubated with different concentrations for various times. 5-FU will be diluted and added to cultures, and genistein will be dissolved in concentrations and later stored in viable temperatures. The effectiveness of 5-FU, genistein and their combination of a proliferation of viability on CRC cells will be determined by a cell proliferation assay, and apoptotic changes will be determined by a DAPI nuclear staining assay. If the hypothesis is supported, these results will lead to significant decreases in proliferation and viability in CRC cells. Genistein may down-regulate NF- κ B signaling pathways, reduce anti-tumor effects of chemotherapy, and potentiate chemotherapy treatments.

Darien High School
Christine Leventhal, Teacher

Sophia Cortellesi

Project #108

Research Proposal, Science, Health and Medical

HIV Antiretroviral Therapy Drugs as a Treatment for Multiple Sclerosis

Currently, 2.5 million people are affected by Multiple Sclerosis (MS), but there is no treatment. Disease modifying therapies (DMT) are used to prevent the progression of MS, but are not able to treat the disease. Symptoms of MS include the inability to walk and speech impediments. Previous studies have shown a relationship between MS and Human Endogenous Retrovirus such as HIV. These studies have indicated a negative correlation between the amount of time being treated for HIV and the probability of developing MS. This relationship suggests that it may be possible to treat MS with Antiretroviral Therapy. The link between HIV and MS makes it probable that MS can be treated by Antiretroviral Therapy. The goal of this experiment is to determine the effectiveness of using Antiretroviral Therapy as a treatment for MS. Three hundred mouse models exhibiting MS will be divided into three groups: one hundred treated with Antiretroviral Therapy, one hundred treated with DMT's, and one hundred with no treatment. Subjects will be observed over a six month span. The severity of MS will be measured by looking at the size of lesions in the brain through MRI's. The results are expected to show Antiretroviral Therapy is an effective treatment for MS. These results will help explain the observed effects on the progression of MS in patients receiving Antiretroviral Therapy for HIV. This experiment could lead to a more effective treatment strategy for MS as well as furthering our understanding of the underlying causes of MS.

Darien High School
Guy Pratt, Teacher

Quin Wolters

Project #109

Research Proposal, Science, Health and Medical

Docosahexaenoic acid's use in preventing the leakage of mouse Blood-Brain Barrier

The blood-brain barrier (BBB) of humans plays a critical role in protecting the brain from unwanted molecules, such as dangerous bacteria and viruses. Over time, the breakdown of endothelial cells, one of the main materials that makes up the barrier, causes it to become leaky, leading to the infiltration of harmful bacteria into unwanted areas of the brain, like the cerebrospinal fluid (CSF). The buildup of amyloid beta protein, produced to kill unwanted pathogens, leads to cognitive decline such as Alzheimer's disease (AD). Docosahexaenoic acid (DHA), an omega-3 fatty acid, is produced in small amounts in the body, and supplemented through consumption of fish oil or fatty fish, among other foods. AD patients have shown low levels of DHA as well as the depletion of long chain omega-3 fatty acids. In order to maintain healthy endothelial cells, an anti-inflammatory diet is preferable; DHA, an anti-inflammatory based acid works to keep these cells strong. In this study, three groups of mice, one injected with DHA, one genetically modified to not produce DHA, and one control of unmodified mice are observed over one year to see if *Escherichia coli* (*E. coli*), and other, non specific bacteria, is found in the CSF. The most likely outcome is that mice genetically modified to not produce DHA, will present with *E. coli* in CSF. If bacteria is found in the CSF of mice at anytime, the BBB is likely to have been penetrated. Lack of DHA, is expected to weaken the BBB of mice. Positive results of this study can influence AD research towards finding new treatments to push back the onset of this progressive disease, affecting 5.4 million people in the USA.

Darien High School
David Lewis, Teacher

Katherine Cunningham Project#110

Completed Project, Science, Environmental

Dimorphism in Ostrich Foramen Magnams and Implications for Dinosaurs

One of the most puzzling questions of paleontology is that of sexual dimorphism. Currently, the only way to determine the sex of a dinosaur is via presence of medullary bone, a type of calcium-rich tissue occurring only in pregnant or previously pregnant females. The issue with testing for medullary bone is that it requires using precision tools to take a cross-section of the fossil, which can destroy the integrity of the specimen. The aim of this research was to find an alternative to destructive sampling methods. The focal point of this study was the foramen magnum (the cranial spinal cord opening), which has been shown to be dimorphic in human specimens, as it is typically larger in males than females. Prior to this experiment, the accuracy of the foramen magnum in sex determination had not been tested outside of humans. This study looked at the paleognathous bird *Struthio camelus*, since they are some of the closest living relatives to the dinosaurs. Linear discriminant analyses (LDA) of the data showed high levels of accuracy in using the foramen magnum for sex determination, although the small sample size in most cases did not allow for statistically significant results. Most LDA tests predicted with 88.89% accuracy the specimen's sex, though there were results as high and low as 100% and 55.56% respectively. Only one test, which utilized only the anteroposterior foramen magnum diameter in its prediction, was found to be statistically significant. Nevertheless, this study offers a promising new alternative to destructive sampling and opens the doors to analyzing a wide variety of species in regards to sexual dimorphism through the foramen magnum.

Darien High School
David Lewis, Teacher

Tim White

Project #111

Research Proposal, Engineering, Health and Medical

Genetic Engineering_CRISPR/Cas9

How are we going to be able to manipulate genetics within an organism to either fix a broken gene or create alterations to change a gene to be able to do another task. My motivation is to cure certain diseases that humanity faces that we do not yet understand/know what to do with. Yes, there will always be more diseases and we will always have a constant battle with them, but the more research and the more testing we do with the ones that we actually know about. I will be looking through Google Scholar at published labs within this area and gaining more knowledge on the subject that I plan to innovate on in the future. As well as learning more about biology and the chemical makeup of the body. This is a proposal, so I have only found/researched on the subject. I have a lot of work to do in the medical sciences and learning more about the small complex workings that surface level classes go over.

Newtown High School
Tim Dejulio, Teacher

Jethin Gowda

Project #112

Completed Project, Science, Physical Science

Study of Size Separation of Sub-Millimeter Sized Granular Material Using Vibro-Fluidization

Granular convection is a phenomenon whereby larger particles rise to the top of a vertically shaken container. Many observations have been made on the effects of a single large particle (~1 mm) within a bath of smaller granules. This work focuses on the separation of comparably sized sub-millimeter diameter particles under the influence of vertical shaking to better understand the dynamics involved in granular separation at sub-millimeter sizes. We mixed volumetric ratios of 4:8 and 6:6 mL of 70 μm tungsten carbide and 50 μm yttria stabilized zirconia milling media and placed the mixtures in 1" dia. glass tubes to undergo vibro-fluidization (60 Hz with amplitudes 0.02-0.07 cm). We imaged the vibration of media in real-time and analyzed the time to separate for several shaking amplitudes. We find that the separation process follows a simple exponential decay function with parameters that can be used to gauge the physical separation process. In addition to measuring the dynamics of separation, we measured the purity of the resultant materials by iteratively vibrating and removing the separated powder. Purity was quantified by x-ray diffraction and scanning electron microscopy imaging of the separated media. We find that after separation the resulting material is 95% pure. This high-purity is remarkable considering the closeness of the particle sizes involved. Granular materials have many industrial and research uses and the need for narrow size distributions is important. Unimodal size distributions for particles this small can be used for additive manufacturing, mineral processing, powder metallurgy, and more.

Amity Regional High School
Deborah Day, Teacher

Corinne Bevill

Project #113

Research Proposal, Science, Health and Medical

The Effect of Stem Cells and Sox2 Lentivirus on Spinal Cord Injuries

Spinal cord injuries greatly impact the lives of victims, leaving them with slight or complete immobility. Studies have tested the possibility of using neural stem cells and transcription factors as a way to regenerate the damaged neurons around spinal cord injuries (SCIs), however no studies have sufficiently clarified which method is most effective in promoting neurogenesis and furthering the longevity of the generated neurons. These methods are the most promising in finding a way to rehabilitate patients beyond invasive surgery. It has been identified that the SOX2 transcription factor via injected stem cells has been the most successful protein in causing regeneration in SCIs. To test these two different methods, a lentivirus would be produced that contains the SOX2 transcription factor, ultimately coding for its regenerative gene sequence. To create the stem cells, human fibroblasts would be extracted and cultured in vitro with a bovine growth serum. After immunocytochemical analysis of these regeneration methods to ensure neural-networking functionality, half of the wild-type mice with SCIs would receive stem cells, and the other half of the mice would receive SOX2-enhanced lentivirus. Every week after transplantation, tissue samples would be extracted for immunohistochemical analysis to identify DCX+ cells (a sign of neurogenesis around the spinal cord) produced by each method. The expected results indicate that injecting the SOX2-influenced lentivirus alone will be more successful, as it does not introduce as many possible causes of rejection as stem cells. If a drastically different amount of cells were produced by one regeneration method, researchers should proceed to clinical trials, bringing patients closer to finding a regenerative method that lessens the daily struggles they face due to SCIs.

Darien High School
David Lewis, Teacher

Nicole Arellano

Project #114

Completed Project, Science, Health and Medical

The effects of environmental factors on overexpressed tau genes in *Drosophila Melanogaster* in regards to neurodegeneration

The number of deaths due to neurodegenerative diseases has recently been on a rise. Alzheimer's disease is currently the fifth leading cause of death and the root of sixty five percent of dementia cases in the United States. This has prompted research in treating and/or curing these diseases. A protein called tau plays an important role in the structure of neurons, or the cells of the nervous system. In a neurodegenerative disease, tau is mutated, accounting for the symptoms seen in neurodegenerative diseases. Studies revealed that, when overexpressing mutant forms of human tau in *Drosophila Melanogaster*, a species of fruit fly, the flies exhibited symptoms similar to those of neurodegenerative diseases in humans. This study sets out to minimize and/or suppress the expression and accumulation of the mutant tau. UAS-Tau *Drosophila* and C155-GAL4 *Drosophila* will be crossed to produce flies that have mutant human tau overexpressed in the neurons. Motor skills will be measured through a bang test for two groups, one of which will be administered a heat shock.

Staples High School
Karen Thompson, Teacher

Jack Yuen

Project #115

Research Proposal, Engineering, Physical Science

Financially Reengineering the Pharmaceutical Industry

The world faces many large-scale problems that lack the research they need to find solutions. One of these problems is that the pharmaceutical sector lacks funding for researching important viruses and diseases. By re-engineering the way pharmaceutical research is currently funded, investors can be attracted to this sector of the market. If we combine a large group of independent and unique research projects into one portfolio then we can aid the research industry and attract investors by increasing the probability of success. Currently research projects offer a low probability of yielding a successful drug and require immense funding. The high cost and low chance of creating revenue makes it a very risky investment that not many people are willing to spend time and money on. In this experiment by combining multiple research projects into a single portfolio, assuming that they have no relative relationship to each other, risk is reduced by utilizing the law of large numbers. In a hypothetical scenario where there is 5% chance that a research project produces a successful drug and the portfolio consists of 150 of these projects, there is a 99.6% chance that just two produce successful drugs. Considering that these projects yield very high return if they are approved, these two successes yield profit and offer an attractive investment. This method that uses a large portfolio of drug development projects can further be improved by using independent research with a variety of focuses, reducing the possibility of error. Financially restructuring the drug development process allows both investors and the world to benefit. In the future, similar techniques can be applied to other issues the world faces.

Darien High School
Christine Leventhal, Teacher

Arushi Samal**Project #116**

Research Proposal, Science, Health and Medical

Isolating Human Embryonic Stem Cell-Derived Cardiac Progenitors in Order to Determine the Function of Associated With Fetal Heart Development

A main component of stem cell regenerative medicine focuses on utilizing human embryonic stem cells to identify cardiac progenitors that can develop and be integrated into a functional human heart. Previously this has been attempted using porcine and murine models unsuccessfully. The reason the cardiac progenitors were not able to integrate and function normally was that the hearts of the model organisms used could not sustain human embryonic stem cells. It has been determined that a population of human embryonic stem cell-derived progenitor cells, the cells with the proteins ROR2, CD13, KDR, and PDGFR gave rise to cardiomyocytes, endothelial cells, and smooth muscle cells. By isolating the cells with these biomarkers, the function of these cells will be elucidated in fetal heart development based on the position of the cell within the heart. The location of the cell within the heart will provide information as to what role the cell has in embryonic cardiac development, such as muscular development, angiogenesis, the formation of blood vessels, or the creation of the chambers of the heart. In order to test this, first-trimester human fetal heart tissues will transplanted in vivo into the ear pinna of SCID mice. Then, ROR2, CD13, KDR, PDGFR positive cells will be inserted into the functioning heart tissues. After 8 weeks, the hearts will be immunostained for each protein. The location of the proteins within the heart will be an indicator of the role the protein plays in embryonic development. Determining the functions of these proteins is vital in order to understand and prevent certain congenital heart defects associated with genetic disorders.

Darien High School
Christine Leventhal, Teacher

Jory Teltser**Project #117**

Research Proposal, Science, Environmental

The Effect of Weather Patterns on the Nocturnal Migration of Birds

This experiment will determine weather conditions in which birds move in large numbers in coastal Southwestern Connecticut during nocturnal migration. It is predicted that strong southwesterly winds followed by a period of sustained cold fronts in the spring will produce the highest concentration of movement. In the fall, the same conditions but with strong northwesterly winds followed by a period of sustained warm fronts will have the same effect. One study tracked the bird movements in several different coastal locations in the Northeast in an effort to understand how topography, winds, and the size of the migration movement affect morning flight (Van Doren et al., 2014). In addition to this, there has also been scholarship done on the importance of research in the field (Farnsworth, 2005). This study will focus on the tracking of nocturnal migration of birds through the use of an acoustic recording setup. It is hoped that the knowledge of what weather conditions produce large movements of birds can help predict when such movements will occur. It is hoped that the knowledge of what weather conditions produce large movements of birds can help predict when such movements will occur. More accurate measurements of these timeframes can help in the conservation of birds in the Northeast, specifically those threatened by extinction.

Staples High School
Karen Thompson, Teacher

IgM Expands Regulatory T Cells and Demonstrates Therapeutic Potential for Type 1 Diabetes

The immune system is able to combat all types of potential threats to health due to its multiple lines of protection and powerful defensive agents. However, this diversity leaves the individual at risk of harm, and autoimmunity can occur if cells of the immune system recognize the body's own tissues as foreign and attack them. Several regulatory mechanisms exist to protect the individual from this danger, such as regulatory T cells (Tregs), a type of cell in the immune system essential for maintaining immune self-tolerance by identifying and eliminating autoreactive cells. However, this regulatory mechanism sometimes fails, and harmful cells remain active in the body. Type 1 diabetes (T1D) is an autoimmune disease which occurs when autoreactive lymphocytes attack and destroy the insulin-producing beta cells of the pancreas. IgM, an antibody produced naturally by B cells, has been previously demonstrated to prevent T1D in non-obese diabetic mice, though the mechanisms by which this result was achieved are unknown. This research studied the effects of IgM on Treg numbers and percentages in samples of human PBMCs and mouse splenocytes in an attempt to understand the specific processes that allow the antibody to prevent T1D. It was found that incubating the cell samples with IgM expanded Tregs significantly, indicating that IgM likely reestablishes self-tolerance through the correction of defects in regulatory mechanisms and the elimination of autoreactive lymphocytes. Though more tests must be done before moving into clinical trials, IgM seems to have substantial therapeutic potential based on its ability to restore immune homeostasis. This research on IgM therapy gives hope to the millions who live with the burden of T1D or other autoimmune diseases.

Darien High School
David Lewis, Teacher

A Novel Approach to the Ease and Accessibility of Early Detection of Chronic Kidney Disease (CKD) to Prevent Onset of End Stage Renal Disorder Through Examination of Urinalysis

According to the CDC, approximately 10% of adults in the US have been diagnosed with CKD. The biggest concern with this disease is that there's no "cure", meaning the only way to prevent kidney failure/ reverse any damage caused is through early detection and then making certain lifestyle changes/ taking medications. Unfortunately, those suffering from the early stages of CKD are unaware of it due to their absence of symptoms. The purpose of the experiments will be to find the best chemical reagent to be administered on a dipstick for early detection of CKD. Chromatography paper will be soaked in three different indicator solutions. The urine of those in the different stages of CKD as well as the healthy will be simulated with synthetic urine and specific concentrations of albumin solution. The color change reactions that occur between each indicator and the various urine samples will be quantitatively compared with a spectronic 20. I expect that the experiments involving 3,4,5,6-tetrabromophenol sulfonephthalein will be the most successful reagents to abnormal concentrations of urinary albumin with a sensitivity rate > 90% and a specificity rate > 85%. Based on the expected results, 3,4,5,6-tetrabromophenol sulfonephthalein can be used as a chemical indicator on a simple, accessible and inexpensive dipstick urinalysis test. This test can be used to not only improve current statistics regarding the five stages of CKD but play a significant role in preventing end stage renal disorder (ESRD), particularly in demographics with high CKD rates, through various lifestyle changes and medical treatments.

Joel Barlow High School
Katherine Nuzzo, Teacher

Jacob Gross

Project #120

Completed Project, Science, Health and Medical

How the Frontal Cortex Connects to the Rest of the Brain: A Study Using Public Databases

Brain connectivity refers to a series of links and connections that exist throughout the brain. Different regions communicate with one another rapidly through complex pathways and circuits. Researchers at the Allen Institute for Brain Science have mapped the mouse brain in 3D using connectivity data. This data is now publicly available online. I am looking to see if the Brain Atlas can be used measure how the frontal cortex connects to the rest of the brain. Methodology for this project will entail extracting raw data from the Brain Atlas. This data, based off of injection location and resulting connectivity, will be analyzed in order to find how connectivity depends on injection location in the secondary motor cortex. Then, the brain connectivity will be characterized based on output to different regions. Although the analysis has not yet been completed, early results indicate a partial correlation between injection location and resulting connectivity. I have analyzed secondary motor connectivity to six different regions, and found a significant trend in three out of those six; the primary visual area, the retrosplenial area, and the anterior cingulate area. Overall, these results indicate that topographical organization is present in some regions related to the secondary motor cortex. Almost of the regions in the isocortex share a high R^2 value, which indicates that depending on injection location, projection density follows a trend. The three regions which exhibit low R^2 values are either part of the motor cortex or in a very differently functioning part of the brain.

Amity Regional High School
Deborah Day, Teacher

Charles Pratt

Project #121

Completed Project, Science, Environmental

The effects of a calendar based and needs based application method on Kentucky bluegrass using nitrogen slow-release fertilizers

This research was motivated by the tremendous issue of nutrient pollution affecting almost every civilization. Second to only climate change, countries like China and the US are polluting waterways and destroying entire ecosystems through fertilizer malpractice. This experiment hopes to show that maintaining turfgrass is achievable without destroying the ecosystem, and requires minimal efforts by the everyday person, farmer, and scientist. The experiment took place in a 15x35 foot plot of land that was divided into 21 plots each 5x5 ft. The fertilizers applied were polyurethane, methylene, and urea. The plots included control, applied by calendar, and applied by amount of nitrogen present. Each plot was labeled with the fertilizer and plot number. Each trial was replicated three times and randomized per row, each row only containing one of each procedure. The experiment has shown that all of the plots lost significant levels of fertilizer. Soil samples were taken 4 times in each plot, to a depth of 4 inches. These samples were analyzed at UConn Storrs' Soil Testing Laboratory. The trend line seen for the data collected during experimentation shows that the amount of nitrate present greatly rose and then returned to normal levels. The experiment was designed around the idea of helping homeowners, and the data seems to support that no matter which process was used, the grass would end up with essentially the same amount of nitrogen. There is potential to argue against applying fertilizer, even slow-release fertilizer, to retain grass strength and greenness during the winter periods. Data will be collected after winter to see the plots' conditions.

Ridgefield High School
Patrick Hughes, Teacher

Olivia Hallisey

Project #122

Completed Project, Engineering, Health and Medical

Temperature-Independent, Portable, and Rapid Home Detection Of Lyme Disease Using a Silk-Derived Lateral-Flow Salivary Test

In the absence of early diagnosis and medical intervention Lyme Disease progresses rapidly, leading to the development of debilitating systemic symptoms and increased risk of “Post-Treatment Lyme Disease Syndrome” (“Chronic Lyme”). Previous research devised a rapid and inexpensive Ebola detection platform that is temperature-independent. Current research develops a rapid salivary test for the presence of Human Lyme Disease IgG antibodies. Utilizing the stabilizing properties of silk fibroin, the ELISA reaction is temperature-independent, confirmed by ELISA colorimetric detection of Lyme after prolonged, non-refrigerated storage of the kit’s reagents. The Lyme ELISA assay was conducted in a 96-wellplate format (A 450nm) at 0-14 days from initial mixing and dilutions. Silk film Lyme ELISA reagents were embedded in load spots on a three channel, paper-based, microfluidic detection card. These colorimetric reagents, positioned to create timed, visible detection of Lyme IgG antibodies, are sufficiently sensitive to test saliva, rather than serum as used in existing protocols. After applying saliva to the center detection zone, 30µl drops of water dissolve the silk-embedded reagents, initiating a timed-flow towards a center detection zone, where a positive (colored) result confirmed the presence of Lyme IgG antibodies in 30 minutes, at a cost of \$5. This rapid, temperature-independent diagnostic flow test permits home testing and self diagnosis, eliminates blood tests, cuts cost, and allows for more frequent testing. Resultant earlier diagnosis and medical treatment permit a meaningful improvement in recovery times and the prevention of “Chronic Lyme”.

Greenwich High School
Andrew Bramante, Teacher

Daniel Brey

Project #123

Research Proposal, Science, Environmental

The Effect of Different Coprophagous Arthropods on the Reduction of the Production of Methane from Feces

I am going test which type of dung beetle is most efficient at reducing the amount of methane produced by feces. There are three types of dung beetles: rollers, dwellers, and tunnelers. Each will be tested separately along with no beetles in another treatment (The control). I wanted to do this project because I’ve always liked dung beetles, and this way I could learn more about their role on Earth. There will be eight tank with two testing each of four treatments: containing tunneler beetles, containing dweller beetles, containing roller beetles, and containing no beetles (Control). Methane will rise into a tube coming out of the top of the tank while fresh air will come into the tank through a tube coming out of the soil. The amount of methane will be measured using gas chromatography. I have not completed the experiment yet. By knowing which type of dung beetle is the most efficient at removing dung, farmers around the world who have dung beetles on their farm (For the purpose of cleaning up their farm and removing a portion of the greenhouse gases) can use solely the dung beetles that are most effective. This will help farmers reduce the amount of greenhouse gases that are largely contributed by cattle.

Joel Barlow High School
Katherine Nuzzo, Teacher

Sarah Barnett

Project #124

Completed Project, Science, Health and Medical

Investigation of the Effectiveness of Bowel Preparations and Physician Rating for Achieving Maximum Visibility in Colonoscopy Procedures to Increase the Detection Rate of Colorectal Cancer

Data, including date of study, physician number, patient date of birth, patient gender, preparation used by patient, and outcome on the Aronchick Scale, were recorded at the time of the procedure at the Endoscopy Center of Fairfield. Consent for the use of non identifying text was obtained prior to the procedure. Outcomes were split into two groups of success, based on criteria currently used by medical professionals. The proportion of success for each prep is: $p_{\text{repopik}} = .79$, $p_{\text{miralax}} = .72$, $p_{\text{suprep}} = .92$, and $p_{\text{movi}} = .95$. After running 2 Proportion Z Test, it can be reported that movi and suprep are equally successful. A chi squared test demonstrated that the outcomes recorded by each physician would not happen naturally 0.05% of the time, proving the subjectivity of the Aronchick Scale. Recommendations to prescribe suprep and movi more often, and to adopt the Boston Bowel Preparation Scale (BBPS), will be reported back to the Endoscopy Center. The BBPS has specific criteria for each point on the quantitative scale, and preserves segmental and physician cleansing differences. Adjusting the rating scale will allow for more accurate comparisons of bowel preparations to demonstrate superior preps which will lead to greater instances of success.

Staples High School
Karen Thompson, Teacher

Samuel Pfrommer

Project #125

Completed Project, Science, Physical Science

Determining Salient Control Decisions of the Actuated Spring Loaded Inverted Pendulum Traversing Slippery Terrain Using a Sliding Mass Model

Legged robot running has long been modeled using a Spring Loaded Inverted Pendulum (SLIP). While the SLIP model has been found to accurately match important dynamic running characteristics such as ground reaction force profiles, it is also highly nonlinear and has no closed-form solution. This study proposes an analytically solvable sliding mass model for predicting energy-optimal key control decisions for a SLIP on low-friction terrain. To evaluate sliding mass model predictions, a series of test scenarios are generated. Each scenario consists of a randomly sized slippery patch with the SLIP positioned randomly over the patch, analogous to a legged running robot stepping on an unforeseen ice patch. Two possibilities are then considered for traversing the patch: stepping back onto firm ground first and then launching over the patch (three stance phases) or stepping directly from the patch to the goal (two stance phases). In order to determine the true energy-optimal solution, both situations are transcribed as numerical trajectory optimization problems using direct collocation. The optimal step sequence from the optimizer is then compared with the output of the simplified sliding mass model, which was found to determine the best sequence with greater than 80% accuracy. These results suggest that sliding mass models can be used to traverse unexpected terrain features in real time, whereas true trajectory optimization often takes prohibitively long to converge. Embracing similar control techniques could lead to the use of legged robots in previously inaccessible terrain, such as a disaster scene or complex natural environment.

Darien High School
Guy Pratt, Teacher

Priti Khire**Project #126**

Completed Project, Science, Environmental

**Clean Oxidation Using
Continuous-Flow Processing**

Continuous-flow processing occurs when all the materials are constantly in motion while undergoing chemical reactions. This process has the potential to streamline the development of clean chemical reactions where no hazardous byproducts are created. This process will come in contrast with batch production where the process happens in stages. How efficient is a flow system for a clean oxidation reaction? We will begin by oxidizing simple alcohols like decanol and benzyl alcohol to the corresponding aldehydes. The process starts by putting an oxidant in a tube and passing the substrate through the bed of oxidant. We will optimize the reaction conditions, such as determining the best residence time and oxidation loading, before screening a range of substrates to show the scope of the method. After each trial with each reactant, the product was analyzed using thin-layer chromatography (TLC). Drops of the experimental product was tested alongside the original reactant and what we knew was the product we wanted. When the TLC plate was placed under a ultraviolet lamp that revealed an oxidation had occurred using a continuous flow process. A cleaner and more efficient chemical reaction for any product has many advantages. The flow system will give scientists an easier time oxidizing their oxidants. It will also provide an eco-friendly alternative to the hazardous byproducts in traditional batch production.

Amity Regional High School
Deborah Day, Teacher

Emily Shaw**Elizabeth Hayman****Project #127**

Research Proposal, Science, Environmental

**The Effects of Increasing Global Surface
Temperature On CO₂ Intake and
Sugar Production Within the Cyanobacterial
Layer of Halophilic Microbial Mats**

This research project will investigate the effects of increased global surface temperature heat on microbial mat communities in hypersaline environments. These mats can be found all over the world. But more relevantly, cyanobacteria (the upper layer of the mats) can be found in the local saline environment of Long Island Sound as well as in harmful algal blooms across the nation, releasing dangerous toxins into its environment, affecting many different ecosystems. We plan to raise cyanobacteria cultures in growth bottles in a heated water bath. After a few weeks of increased temperatures we will biomass the cyanobacteria to analyze sugar content. We will biomass the bacteria to analyze the sugar content and compare between different temperatures and a control. If there is a raised level of sugar production, this would mean that there is equally a rise in methane production.

Joel Barlow High School
Katherine Nuzzo, Teacher

Jonathan Lam

Project #128

Completed Project, Science, Environmental

Experimentally determining the total lasting albedo effect of aerosol-seeded clouds based on aerosol particle type

Global climate change is the factor that most endangers mankind and the biosphere, especially with global warming and its adverse effects. Scientists have recently been looking seeding clouds by spraying aerosols into the atmosphere to serve as cloud condensation nuclei (CCN). My experiment aims to add data regarding particle suspension over time and albedo (reflectivity) of different particles to the current research. The experimental design will consist of a long, rectangular, light-impermeable box. There will be two holes cut into the same end, close together, to allow for a flashlight and a luxmeter, and another hole on the side for aerosol entry. After the aerosol is injected into the chamber, the flashlight will be turned on and the brightness of reflected light will be recorded at regular intervals. Repeat for each aerosol. The data will be interpreted as a function of albedo over time. Albedo is determined by reflected light divided by incident light (which will be determined by shining flashlight directly into luxmeter). Graphs will be drawn and compared and the data will be tested for statistical significance to verify that this novel experimental design indeed did provide accurate results. The aerosol with highest area under curve is most reflective overall. Researchers will be able to use this data to more specifically control the amount of reflective cooling they want their aerosol to have. A larger albedo and time in atmosphere before deposition means more reflectivity and more global cooling. On the other hand, researchers may also want to use less reflective aerosols to provide a more controlled effect on the atmosphere.

Joel Barlow High School
Katherine Nuzzo, Teacher

Dana Estra

Project #129

Completed Project, Science, Environmental

The Effect of Concentration of Heavy and Light Duty Vehicles in Traffic-Impacted Streets in New Haven on Levels of PM_{2.5}

Fine particulate matter, when in high concentrations, can be inhaled deep into the lungs and have negative respiratory impacts. One of the main sources of fine particulate matter is vehicular pollution. This project is comparing fine particulate matter levels to concentration of heavy and light duty vehicles. It is hypothesized that when there is a greater concentration of heavy duty vehicles on the streets, particulate matter levels will be higher. The Optical Particle Monitor OPC-N2 will be used to measure particulate matter levels from 5:00-5:30 pm every day from January until March. The street will be videotaped and the number of heavy and light duty vehicles will be recorded. This will be performed on George Street and Fountain Street in New Haven. A statistical analysis will be conducted to see if the difference in pollution levels are significant. A statistical analysis will be conducted to conclude whether fine particulate matter concentration and the concentration of heavy duty vehicles are correlated. It is projected that there will be a positive correlation, and the data will support the hypothesis that heavy duty vehicles on the road result in greater levels of roadside fine particulate pollution. This project is significant because roadside pollution has very negative effects on human health, especially particulate matter smaller than 2.5 microns in length. By gaining more knowledge on the correlation between vehicle weight and pollution levels, there will perhaps be a greater drive to make an effort to reduce roadside air pollution.

Amity Regional High School
Deborah Day, Teacher

The Effect of Valencia Orange Oil in Bat Caves Infected with White-Nose Syndrome

White-nose syndrome (WNS) is a cutaneous fungal disease that has killed more than 7 million bats since its emergence in North America in 2006. The associated fungus, *Pseudogymnoascus destructans* (Pd), is psychrophilic, or cold-loving, and strikes bats during their hibernation. When a bat enters hibernation in early winter, its body fat content is high to enable it to survive months without daily sustenance. As the fungus irritates the skin of the bat and affects its physiological processes, the bat interrupts its lethargic state of torpor more often than usual. This causes a premature depletion of body fat which ultimately kills the bat. Chemical fungicides and bacterial isolates are among the remedies that researchers have tested to inhibit Pd, but none have been consistently effective. A recent study shows that cold-pressed Valencia orange oil is a strong inhibitor of Pd in vitro because of its ability to break down fungal cell walls. This proposal makes use of Valencia orange oil in vivo. When bats that have survived the winter migrate to their summer habitat, the empty caves remain infected with Pd, which reinfects the population upon its return. An experiment would be done in which an empty cave, known as a WNS site, is sprayed with Valencia orange oil several times over the summer. Population censuses would take place the winters before and after the implementation of orange oil, and are projected to show an increase in survival after the spraying. This would suggest that the oil does in fact inhibit white-nose syndrome and could be sprayed in caves across North America, potentially saving millions of bats.

Darien High School
David Lewis, Teacher

The Effect of MN250 on the Removal of Sulfonamide Antibiotics in Wastewater

Sulfonamide antibiotics treat urinary tract infections and malaria. It is also used in animal feed. This leads to these antibiotics being in runoff into bodies of water. There are many current processes of antibiotics removal, but hypercrosslinked resins provide more advantages than traditional processes. They exhibit high adsorption capacity, easy regeneration, and low cost. MN250 was determined to be the most effective adsorbent in removing sulfamethazine in distilled water. Sulfamethazine, sulfathiazole, sulfamethoxazole, sulfamerazine, and sulfadimethoxine concentrations will be the same for all batches. Antibiotic concentration will be periodically measured over 240 hours by the ELISA test they reach equilibrium. There will be differing pH, humic acid, and ion concentrations to test the adsorption capacity of MN250. The outcomes will be graphed by Langmuir and Ho's Pseudo-Second Order Model and an ANOVA test will be used to determine statistical significance. The predicted ANOVA test results will be that the outcomes of this experiment will be statistically significant. MN250 will prove to be at least as effective in removing sulfathiazole, sulfamethoxazole, sulfamerazine, and sulfadimethoxine from differing water conditions as it is removing sulfamethazine. Results from this experiment can be used to further confirm the effectiveness of MN250 in removing the sulfonamide family of antibiotics. These results can be used to design another experiment to look at differing methods or the effectiveness of MN250 in removing emerging antibiotics in the Great Lakes.

Staples High School
Karen Thompson, Teacher

Alexandra Herrmann
Stephanie Beshoory

Project #132

Research Proposal, Science, Environmental

Determining the Optimum Habitat Conditions for Sea Turtles in Captivity

Many sea turtles are injured and placed in sanctuaries until they can get stronger and can be released into the wild. Captivity can be difficult for sea turtles and can decrease their chances for long-term survival. Leatherback sea turtles are particularly difficult to keep in captivity since they are not well adapted for enclosed systems and hard surfaces. Their softer skin is often irritated by tank walls, which can lead to sores and infections. This study seeks to determine the best way to allow turtles to thrive in captivity so that they will have a better chance of survival in the wild. The study will have three parts and each part will involve two turtles. All turtles will be the same age and have the same injury or illness. In the first part, two turtles will be kept in separate enclosures, one with a traditional hard texture and one with a softer foam texture. All else will be controlled. In the next part, two turtles will again be kept in separate tanks, one with a dark color that represents the habitat in the wild and one with a light color. All else will be controlled. In the third part, two turtles will be placed into two separate tanks with one tank enriched with things seen in the wild (coral, small fish, etc.), and one tank completely empty. All else will be controlled. The behavior and health of all turtles will be monitored daily. Since it has been shown that fish with enriched tanks tend to have an increased chance of survival in the wild, the same is expected for the sea turtles. In addition, the turtle in the softer foam enclosure and the turtle in the dark color enclosure most similar to its natural habitat will both do better than their counterparts. This study may reveal vital information on how sea turtles should be treated in captivity so that they have a higher chance of survival in the wild, which will increase the general sea turtle population.

Convent of the Sacred Heart
Mary Musolino, Teacher

Jason Katz

Project #133

Research Proposal, Science, Environmental

The Effect of Species of Algae on Production of Biofuel

The availability of fuels that humans are extremely reliant on in their daily lives is rapidly depleting, and soon enough, they will be gone. Conventional crops such as corn and soybeans are currently being used, but it only contradicts efforts to impede the global food crisis that might arise in the future. Since the key characteristics of an algae that would be effective in biofuel generation is a high lipid productivity and growth rate, the central question in the experiment is related to determining which species of algae would prove to be the best producer of oils for the synthesis of biofuels. The hypothesis stated that if the algae with the highest growth rate and lipid productivity is used, then the quantity of oils for biofuel production will be at its highest. Between *Oedogonium*, *Spirulina*, and *Spirogyra*, it is predicted that *Oedogonium* will produce the greatest quantity of oils since it has the greatest lipid productivity, its biomass before oil extraction is greater than *Spirulina* and *Spirogyra*, and it was recorded that it had a higher oil extraction in the experiment that compared *Oedogonium* to *Spirogyra* (Figure 2). That materials required for this experiment are minimal and solely consist of a photobioreactor/s, a light source, a source of carbon dioxide, and samples of the three species of algae being tested. An ANOVA test will be used to analyze the data and the results should display that the amount of oil produced from each species of algae is significantly different. This experiment can be further expanded by testing a greater variety of species of algae for oil extraction in future experiments and to see if other characteristics of the algae such as dry mass are as vital for high oil extraction and if the same results can be concluded.

Staples High School
Karen Thompson, Teacher

Adam Boczar

Project #134

Research Proposal, Science, Environmental

The Effects of Various Environmental Changes on the Production of Oxygen Gas and Chlorophyll fluorescence in the Chlorophyll f Pigment with *H. hongdechloris/C. fritschii*

How can the conditions of the environment for *Chlorogloeopsis fritschii* be manipulated to optimize the rate of photosynthesis and the photosynthetic rate for the cyanobacteria? I am doing this project as global climate change effects the environments of the world, I would like to see how this affects this bacteria as it is a crucial organism for the process of photosynthesis. There will be two main parts to my experiment. For one portion, I will be growing the cyanobacteria in several cultures for a period of three weeks, measuring the amount of oxygen gas evolved in each culture, measuring the rate of photosynthesis. The cultures will be under near infrared light or natural light, with 5 and 5 respectively. I will be conducting chlorophyll fluorescence to observe the chlorophyll f pigment. I will find the quantitative data being the amount of oxygen evolved from each culture to compare the optimization of photosynthesis under various temperatures. I will conduct statistical tests like the t-test to determine the significance of my results and to determine the effect of elevated and lowered temperatures has on these cyanobacteria. I hope to draw a conclusion of the novel, practical utility of cyanobacteria as a possible method to reduce atmospheric carbon dioxide in the future. I would like to show that under this near-infrared light the rate of photosynthesis is optimized, while also emphasizing of these bacteria under various temperatures.

Joel Barlow High School
Katherine Nuzzo, Teacher

Alexandr Palvinski

Michael Klein-Wassink Project #135

Research Proposal, Science, Environmental

Analysis of the Effects of *Selenastrum Capricornutum* on the pH of Freshwater Marine Environments

The burning of these fossil fuels yields the release of carbon dioxide gas in the atmosphere. The excess CO₂ in the atmosphere dissolves into ocean water, in turn increasing the acidity of the ocean and lowering the pH. This is called ocean acidification. Scientists have used saltwater algae to help deal with this problem, but our group is wondering whether there is a freshwater alternative to help combat this in lakes and rivers. We will use 3 aquariums filled with deionized water, bubble in CO₂ to mimic the acidification, and place algae cultures in the tanks and measure their effectiveness at combating the decreased pH. Using a pH kit, the pH change will be recorded and a spectrophotometer will measure the concentration of algae to see if it is able to sustain itself or even grow under these conditions. None yet, as this is still a proposal. The results will come in within the coming weeks. None, since there aren't any results that can be used for any implications

Joel Barlow High School
Dr. Katherine Nuzzo, Teacher

Thomas Livesay**Project #136**

Completed Project, Science, Environmental

Determining the Ideal Management Strategy for Controlling Varroa Mite Levels

In the recent years, a decline in bee population has been seen worldwide. A mite has been implicated called Varroa destructor, which vectors viruses in developing bee pupae causing increased bee mortality. The objective of this study was to find the ideal management strategies for beekeepers to use to keep mite levels below the economic threshold thereby improving overall Apis mellifera bee health. Independent Variables were different management strategies, chemicals, drone brood removal, sugar dusting, brood interruption, VSH queens, screen bottom boards and combinations. Dependent Variables were mite loads, colony loss and diseases like Deformed Wing Virus (DWV). It was hypothesized that the ideal strategy would be combinations of nonchemical strategies like brood removal, and would decrease dependent variables. The data for this study was obtained from Northeast US region surveys. The data was statistically analyzed with ANOVA testing to determine significance of the impact different methods actually had on the Varroa mite load for different colonies, virus presence, and colony loss. Projected data results could show that the natural treatments of VSH queens and drone brood removal/interruption decreased dependent variables. Data was also analyzed with T-tests to compare variables with each other. Varroa load initially looks to be the best method of determining effectiveness. The implications for this project are numerous. Firstly it could benefit the beekeepers understanding of management strategies effectiveness, and how beneficial they are, especially considering current overuse of chemical treatments. It could also be applied to other species of bee and similar mites to manage them. Also, it could spread awareness of the dangers of Varroa destructor.

Amity Regional High School
Deborah Day, Teacher

Erin McCormack**Project #137**

Completed Project, Science, Physical Science

SH3 Protein Folding Effects on the Formation of Amyloid Fibrils Using Optical Tweezers Microscopy

The SH3 protein structure is found to form Amyloid Fibrils in the brain of people suffering with many diseases. The protein is found to have three different states: completely folded, completely unfolded, and half-folded. Bonding is suspected to occur in this half-folded state, yet not widely researched. This project will research the SH3 protein and observing the state in which it bonds to another SH3 protein to form Amyloid Fibrils. I will harvest the protein by introducing it to a bacteria. I will separate a single protein from the rest of the bacteria and chemically bond it to two small glass beads through DNA strands. I will move the glass beads through the process of optical trapping and pull the protein and observe how it stretches and changes the form it is in. The anticipated results of this project, based on previous research, is that the protein will stay in the half-folded state for about half the time, but it will change frequently between each state. I will analyze length of time in the half folded state, the percent of time in the state, and the switches between states. I will examine how the protein reacts to different amounts of force applied to it. This data can be used to create different ways of finding cures to many diseases. Since this protein is found in the brains of people with many diseases, it could be the cause of the disease or some side effects of it, so knowing more about it will increase knowledge on how to cure or help people with this disease. This knowledge will increase understanding of many different diseases.

Amity Regional High School
Deborah Day, Teacher

Luca Cerbin

Project #138

Research Proposal, Science, Environmental

The Ameliorating Effects of Biochar and Fertilizer on the Amount of Organic Carbon and Total Organic Matter in Native Connecticut Soil

I would like to find out how well biochar and fertilizer can work together to improve soil quality. Soil across the world is dying and finding a way to prevent that is necessary to sustain life on Earth. I will be using biochar with chemical, organic, and no fertilizer. This will be put in the soil that a Wisconsin Fast Plant will be growing in. In order to collect data soil samples will be measured for mass, then combusted, and then measured again to find the amount of organic carbon in the soil. This will be multiplied by the Van Bemmelen Factor to find total organic matter. None yet. None yet.

Joel Barlow High School
Katherine Nuzzo, Teacher

Andrew Benz

Project #139

Completed Project, Engineering, Physical Science

Determining the Optimal Implementation for Secure Multiparty Computation of the Logistic Function

Secure multiparty computation is a technique in cryptography that allows for two or more parties to compute an arbitrary function over their inputs without revealing their inputs to the other parties. Yao's garbled circuit protocol provides a method of implementing secure multiparty computation between two parties over any arbitrary function by first converting the function into a Boolean circuit and then converting each gate in the circuit into an encrypted form. The objective of this research is to determine the most accurate and efficient method of implementing the logistic function in the secure multiparty environment. The logistic function, defined mathematically as the reciprocal of one plus the exponential function reflected about the y-axis, is commonly used in neural networks, where the behavior of each neuron in the network is mathematically modeled using the logistic function. The methods of computing the logistic function that were included in this research were Taylor series expansions, Remez's algorithm, and a bitwise algorithm based on the exponential function. Obliv-C, a wrapper for the GCC compiler that converts numeric operations used in C programs into Yao circuits, will be used for the implementation. Performance will be measured using wall clock time, i.e., the time elapsed between the initialization of the protocol and its execution. The efficient and accurate implementation of a logistic function for secure multiparty computation could lead to the development of secure computation for neural networks, which would have real-world applications for the pharmaceutical and finance industries.

Darien High School
Christine Leventhal, Teacher

Kailey Lauter**Project #141**

Research Proposal, Science, Environmental

How Carbon Dioxide Levels Affect The Geographic Expansion of *Borrelia burgdorferi* and The Spread of Lyme Borreliosis

I will be researching how atmospheric carbon dioxide levels affect the geographic range of *Ixodes scapularis* and the number of lyme disease cases that emerge. My motivation for investigating this topic is to discover more information regarding lyme disease to reduce the number of lyme disease cases by predicting where the most cases will emerge. I will be conducting a statistical analysis. The procedure will consist of running an ANOVA test to correlate three variables: atmospheric carbon dioxide levels, nymphal tick migration into Canada, and the number of lyme disease cases in Canada. I do not have any findings or results at this point in time, as I have not yet conducted my statistical analysis and correlated my variables. I will use my data to raise awareness about lyme disease and where cases are most likely to emerge, in hopes that the annual rate of emerging lyme disease cases will decrease.

Joel Barlow High School
Katherine Nuzzo, Teacher

Nikzad Khani Project**#142**

Completed Project, Science, Health and Medical

The Effect of Concussion Severity on Eye-Gaze Patterns

Currently it is difficult to identify the severity of a student athlete's concussion as current diagnostic tests do not give reliable measures of strength. A measure of strength is extremely important for treatment as doctor's often times have difficulty diagnosing a specific duration for rehabilitation. An eye-tracking device that records an athlete's performance in terms of eye fixations and durations would be able to help in this diagnosis. In this experiment, a group of athletes will take an eye-gaze pattern test which I will design at the beginning of their season to be set as a baseline. If an athlete is suspected of getting a concussion they will receive a second test and their deviation in performance from the baseline will be recorded with a doctor's diagnosis of the concussion serving as a measure of concussion severity. The independent variable is the concussion severity based off the rehabilitation period that David Wang MD prescribes and the dependent variable is the eye-gaze pattern deviation. The rehabilitation period will be used to correlate eye-gaze pattern deviations with rehabilitation periods to create a tool for prescribing a length of treatment. It is expected that as the concussions severity increases, the deviation from the baseline will increase. This association will then be analyzed for a new way of diagnosing concussions and their severity since the amount of deviation will be correlated with how severe their concussion is.

Amity Regional High School
Deborah Day, Teacher

Aircraft Wing Storage Methods for Aircraft Carriers

Modern day aircraft carriers carry planes within the Hangar Deck on the inside of the ship, to be delivered to the Flight Deck on the top of the ship for launching and landing. In order to fit more aircraft in the carrier, naval aircraft are designed with some method of making their wingspan shorter while in storage. This study would present methods to store aircraft wings inside aircraft carriers, in order to determine which method would allow for the maximum number of aircraft stored on a carrier and the best flight performance of the aircraft. Three wings would be tested using a full folding-wing, a Variable-Sweep wing, and a wingtip-folding wing. Each of the wings would be based on the same F/A-18C/D fuselage to make sure the only variation is wing design, and measured for storage on-board an aircraft carrier and tested for performance. In order to do this, a series of flight tests would be run on the wings, such as wind tunnel testing and maintenance lengths. The maximum altitude, maximum flight speed, lift-to-drag ratio, thrust-to-weight ratio, maximum turning time (to complete a full 360o loop), and weight would all be recorded. In addition, the wingspan would be measured to determine how many aircraft would be able to be stored in the aircraft carrier. It is predicted that the full folding-wing will be the most effective over the other two methods, because it will allow for equal storage to the Variable-Sweep wing without the added weight of the sweeping mechanism. Using the best option possible would allow for the US Navy to operate the Carrier Air Wing at maximum efficiency.

Darien High School
David Lewis, Teacher

Using Phagocytes to target malignant white blood cells in Leukemia

In the immune system, phagocytes are used to fight disease throughout the body, and are transported through the circulatory system to the location of most need. However, phagocytes are unable to effectively combat leukemia alone, because the disease is the cells themselves. In leukemia, the cancer begins in the bone marrow, resulting in high numbers of phagocytes unable to function as they normally would. The over-crowded diseased bone marrows cannot make other blood cells necessary for bodily functions, including red blood cells and platelets. The diseased white blood cells are exactly the same structure-wise as normal phagocytes, but they are undeveloped and cannot fight diseases. It is hypothesized that the use of nanomedicine targeted therapy will increase the effectiveness of chemotherapy in leukemia. The healthy white blood cells that accumulate around cancer-affected areas can be used to target these cancer affected areas, in order to accurately and more efficiently deliver leukemia cancer therapies such as Cladribine (Leustatin®, 2-CdA), Fludarabine (Fludara®), or Topotecan. Using nanoprecipitation and nanomolecules, there can be targeted delivery of treatment. It is predicted that nanomedicine targeted therapy will increase the amount of cancer being treated by the chemotherapy and therefore greatly increase the effectiveness of the cancer treatment. It is predicted that using a hydration layer around the nanomedicine will protect it from other phagocytes who will attack it. Leukemia infects around 20,000 people each year, and the most popular therapy is a bone marrow transplant which is an extremely painful and difficult procedure. New methods of treatment can reduce the pain and difficulty of the replacing of the bone marrow, as well as reduce the deaths from the cancer.

Darien High School
David Lewis, Teacher

Noah Sonnenberg

Project #145

Completed Project, Science, Environmental

Design and Analysis of Melanoides Tuberculata and Physidae in a Sustainable Aquaponic System with no Input

This research focuses on increasing the sustainability plant cultivation in a closed system. In the designing process, Melanoides Tuberculata and Physidae were used for species Tomatoes reached a height of 10 inches, showing a 1-inch average, which is comparable to traditional methods. This new system has the potential to improve world hunger.

Greens Farm Academy
Mathieu Freeman, Teacher

Ella Holl

Project #146

Research Proposal, Science, Health and Medical

Fighting Chronic Pain With Chocolate

Chronic pain causes restrictions on a person's everyday life. On top of working through constant pain that does not go away, there is a huge psychological factor involved, which makes chronic pain such a complex condition. Dark chocolate is a food that brings many health benefits from the high percent of cacao that can boost one's mood and serve as an anti-inflammatory without the harmful effects of medication. Research has found that people who rated themselves highly stressed had lower levels of stress hormones after eating chocolate every day for two weeks. This experiment proposes to study the additional potential benefits of chocolate to see if it can serve as long term relief for individuals living with chronic pain. Some work has been done in the area of chocolate and pain relief, but more research is needed within the realm of chronic pain. In this experiment, three groups of people facing chronic pain will be distributed equally. Group 1 will serve as the controlled group (taking neither chocolate or ibuprofen), group 2 will take chocolate at 9am and 9pm for two weeks, and group 3 will take ibuprofen at 9am and 9pm for two weeks. All groups will be closely monitored for mood and pain to see each group's effects from their treatment. In order to test long term benefits; the patients will be reevaluated a month later on how they are feeling. This research will add to the knowledge that exists regarding the best way to treat chronic pain.

Convent of the Sacred Heart
Mary Musolino, Teacher

Jenna Ledbetter

Project #147

Research Proposal, Science, Environmental

Effects of Climate Change and pH Change on Daphnia Population Size and in turn Entire Freshwater Ecosystems

Several Daphnia species are considered threatened. Daphnia are very important components of freshwater food chains. They consume algae, bacteria, and other small organisms. They are then preyed on by small fish and other aquatic animals. Daphnia are also important to humans for both research purposes and for preserving freshwater ecosystems. Daphnia are translucent and their anatomy can be observed. Additionally, Daphnia can be used to test for toxins in freshwater ecosystems. Great indicator species. Freshwater sources constitute a valuable resource for economic, scientific, educational, and cultural terms. Protection of biodiversity in freshwater ecosystems is essential for humans. For this reason, this research is necessary in order to preserve Daphnia population and in turn freshwater ecosystems as a whole. Water Fleas, Daphnia, are small water crustaceans that serve as a food source for many species of freshwater fish. Daphnia live in a range of environments including freshwater lakes, ponds, streams, and rivers. For my research project I will be simulating pond ecosystems and changing pH and temperature in accordance to climate change in Maine in order to find how these environmental changes affect Daphnia population in terms of reproductive rate and heart rate. Daphnia have translucent bodies which can be observed on a microscope slide without harm to the creatures. When Daphnia are living in an unfit environment they begin reproducing asexually and solely produce female clones. I will investigate the number of males versus females in subsequent populations. Environmental changes will affect Daphnia population size. Additionally, in the less habitable environments there will be less male Daphnia causing population size to begin to shrink. By putting the Daphnia in environments that differ from those they thrive in, physiological changes can be observed and recorded. I suspect that these changes will be an increased heart rate, and a female dominated population. so far project is solely a proposal.

Joel Barlow High School
Katherine Nuzzo, Teacher

Tanmay Mehta

Project #148

Research Proposal, Science, Health and Medical

Comparison of RNA-seq Analysis of Healthy Platelets and Platelets from Coronary Heart Disease To Determine Molecular Mechanism of MRP-14 Gene

Coronary heart disease is the leading cause of death in America, taking 610,000 lives annually. This disease arises mainly from atherosclerosis, the formation of lesions on the arterial wall. Platelets are directly involved in this process, aiding the clotting of these lesions, but the eventual buildup of platelets and red blood cells form a bulging plaque on the arterial wall risking myocardial infarctions. To help treat these patients, researchers must first determine the gene expression levels in platelets with this disease and then ascertain the direct molecular mechanism of the MRP-14 and other significant genes. This study will utilize paired-end RNA sequencing on the Illumina GAIIx sequencer to characterize the transcriptomes of the two types of platelets. Previous studies have indicated an increase in the expression of myeloid-related protein-14 in the transcriptome of platelets with coronary heart disease; therefore, in the proposed experiment, MRP-14 genes will be stained and analyzed with a flow cytometer to compare the prevalence of this gene's expression on the platelet transcriptomes. Then, the role that MRP-14 genes hold will be evaluated by comparing the effect of a femoral artery injury on wild-type mice with MRP-14 genes and mice that lack this gene. It is expected that there will be a significant increase in the expression of MRP-14 in platelets from patients, and the role that this gene has will likely relate to the proliferation of leukocytes. The results of this experiment will determine if there is a change in expression of MRP-14 in healthy and diseased platelets and will indicate whether this gene is a novel target for treating coronary heart disease.

Darien High School
Christine Leventhal, Teacher

Alexander Scheck

Project #149

Completed Project, Engineering, Physical Science

Drone collision avoidance using a lidar sensor and PWM modification

Currently there is a growing popularity in drones as they are affordable and small. There are currently no regulations on who can buy or make them. With a greater number of drones in the hands of inexperienced operators, this could lead to an increase in accidents and potential harm. To solve this problem the plan is to create a collision avoidance system to be used on drones. Two lidar sensors will be mounted on a 360 degree servo that is attached to the drone. One sensor will always be facing the opposite direction of the other. The measurement from the sensors will be used to generate a 2D digital map. The data will then be read by the control board to take the most desired and safe path. The collision avoidance system should be able to detect and avoid irregular objects. It is expected that errors in the programming code will require troubleshooting. The test will include outdoor scenarios involving trees, poles, and other irregular objects. A successful obstacle avoidance system can make drones safer. Currently the FAA has begun implementing regulations that require operators to register their drones. This could be the next step in helping the development of drone safety and preventing accidents.

Ridgefield High School
Ryan Gleason, Teacher

Manuel Carballo

Project

#150

Completed Project, Science, Environmental

Remediation of Beryllium Heavy Metal via *Phaseolus vulgaris* Hyperaccumulation

The problem was that there were no known hyper-accumulators of Beryllium that could be used for bio-remediation of contaminated areas. The motivation came from reading about the Animas River spill where the EPA spilled 3 million gallons of heavy metal contaminated water, including Beryllium, and how bio-remediation was being used to bring the area to its previous state. But research I did showed no hyper-accumulators of Beryllium being known so I set out to find one. Kidney bean plants and Ryegrass (the control) was grown being exposed to Beryllium Sulfate in water and also just normal tap water as a control. These plants were given 8 weeks of exposure. After the 8 weeks samples were collected from the leaves and roots of each plant. The samples were digested using Nitric acid and then sent to a lab to be analyzed by ICP Atomic Absorption Spectroscopy. Kidney bean plants can be used as a hyperaccumulator of Beryllium in soil where the Beryllium compound is water soluble. This was determined because compared to Ryegrass, which is not a known hyperaccumulator of any heavy metal, the ICP results showed that Kidney Bean absorbed over 106 times as much Beryllium Sulfate, suggesting that it had enough Beryllium absorption capabilities to be considered a hyperaccumulator of Beryllium. This project shows that Kidney Bean plants could serve as an effective hyper-accumulator of Beryllium in areas contaminated with the metal. This means that to get rid of the toxic metal one would plant lots of Kidney Bean plants over the area and after 2 months or so the plants can be removed, taking the Beryllium with them. The plants are not to be eaten though, since the toxic Beryllium will be absorbed in the plants and can be toxic to eat.

Greenwich High School
Andrew Bramante, Teacher

Qingli Hu Project

#151

Completed Project, Science, Health and Medical

Investigating the relationship between NLRP6, Gut Bacteria, and Antimicrobial Peptide Release

Nucleotide-binding oligomerization domain-like receptor pyrin domain 6, or NLRP6, is a protein which helps prevent intestinal inflammation. Recent studies have shown that NLRP6 knock-out (KO) mice display lower type-1 diabetes incidence compared to NLRP6-sufficient wild-type (WT) mice, and that NLRP6 helps produce antimicrobial peptides (AMPs) that work to control bacteria in our intestines to prevent infection. The central question of this project is: Do gut bacteria influence AMPs release? The experiment will be investigated using Germ-free (GF) WT mice. Fecal samples are collected from SPF WT and KO mice; the gut bacteria from those mice are gavaged into GF mice. The small intestinal and large intestinal tissues are harvested. I will isolate RNA and transcribe the RNA, using the PCR machine, into cDNA. I will conduct a qPCR to measure intestinal AMPs gene expression, REG3 β and REG3 γ . In the results, it is clear that bacteria in WT and NLRP6-KO mice are different. Mice that received bacteria from KO mice showed a higher AMP expression; KO bacteria in GF mice increases AMPs release in the intestines. However, compared to data from SPF mice, though the general trend is the same, the difference in AMPs release between WT and KO mice is smaller in GF mice. Both bacteria and AMPs release are different in WT and NLRP6-KO mice, so the presence or absence of NLRP6 is significant. The results of this experiment further clarified the relationship between NLRP6, gut bacteria, and AMPs release and suggests that gut bacteria influences AMPs release. Since NLRP6 deficiency is also found to reduce type-1 diabetes incidence, the connection between it, gut bacteria, and AMPs is an important one to understand.

Amity Regional High School
Deborah Day, Teacher

Nephtalie Rene, Gianna Morano Abigail Leyson Project #152

Research Proposal, Science, Behavioral

The Correlation Between the Diversity of a City and its Local On-Camera News Personnel across the Nation

Racial bias in the media has been shown in several studies, for example, through criminal news reporting. However, studies have not been conducted regarding on-air representation at news stations and how well this representation correlates with the demographics of the city. The purpose of this research study is to determine if the diversity of local news stations in major markets across the country correlates with the demographics of the city. It is hypothesized that the demographics of the city will not match the demographic percentage of the on-screen news teams in the majority of the cities studied. The popular local news stations in each state capitol will be used to collect the data of on-camera news staff, and the United States census website will be used for the needed information on demographics. The percentage of people for all races will be documented and compared to the percentage of each race of the on-air news personnel in each city. It is expected that the diversity of a community will not be represented by the diversity of the local newscasters. This study is significant because it will signify the need for change and increase awareness of the media and newscasts regarding racial biases.

Convent of the Sacred Heart
Mary Musolino, Teacher

Samantha Ballas**Project #153**

Research Proposal, Science, Health and Medical

The Effect of Increasing Water Temperature and Decreasing pH on Vibrio Cholerae Cases

Many people in the world, particularly those in developing nations with limited access to healthcare, are affected and some killed by Cholera. My motivation is to use data to help countries predict the incoming case numbers so that they can prepare I am planning to run a statistical analysis on primary source data to determine if there is a significance and then devise a plan to help the healthcare systems of affected areas using strategies from areas that already work well. None yet Not able to do so until data is complete

Joel Barlow High School
Katherine Nuzzo, Teacher

Tyler Gordon**Project #154**

Research Proposal, Science, Environmental

Analyzing the Impact of Fertilizer Runoff on Lake Algal Biomass

Every summer, algal mats cover the surface of Lake Mamasasco, restricting public access to the lake. Waterside properties surround the lake, therefore chemicals (primarily coming from fertilizers) can easily runoff into the lake water, initiating the process of eutrophication. If the amount of chemical nutrients required to start eutrophication can be measured, then there is a potential to restrict eutrophic consequences such as algal blooms from occurring. Twelve areas of the lake will be roped off, and nets will be dropped down to completely separate the areas from the rest of the lake. Algal biomass will be measured in each section, respectively. Next, different amounts of phosphorus-rich fertilizer will be imbedded beside ten of the sections, with two sections kept natural as a control. Algal biomass will be measured once every seven days for approximately four months. The predicted results of this experiment will conclude that the section of the lake with the most fertilizer imbedded will see a higher algal biomass than the other sections. From there, the next most fertilized section will have the next highest algal biomass, and so on. The control sections will still see an increase in algal biomass, due to the natural occurrence of eutrophication in the lake. If the anticipated results are accurate, then they can greatly further the understanding of eutrophication in the science community. By comparing the differently fertilized sections to the two controls, reliable conclusions could be drawn about the relationships between additional phosphorus nutrients and algal biomass growth. This would eventually influence eutrophication prevention methods, allowing Lake Mamasasco in particular to once again become safe and accessible for all living things.

Ridgefield High School
Ryan Gleason, Teacher

Tristan Filiato

Project #155

Research Proposal, Science, Environmental

Using Basidiospores to

This experiment will observe the effects of basidiospores on condensation and in the nucleation of water droplets. Previous studies have indicated that there may be a correlation between certain particulate matter in the atmosphere and the nucleation of water droplets, particularly with basidiospores. This experiment will further study the correlation between nucleation and basidiospores to reach a quantitative conclusion on whether or how much basidiospores effect the nucleation of water droplets. This experiment will take place in a sealed, water tight environment, probably in two sealed glass tanks. Within each one will be a beaker with the same amount of water to ensure similar humidity levels. In one of them will be basidiospores, released into the atmosphere of the tank. A camera will be set near the tanks, and will be set to take a photo every minute. The time of each photo taken will be recorded. Each photo taken will be analysed for water droplets on the sides of the tank. This experiment is expected to discover whether basidiospores cause a significantly different rate of water droplet nucleation than if they were't in the atmosphere. This will be measured by whether condensation occurs on the sides of the glass tank at significantly different times. This would indicate whether condensation is affected by basidiospores because it would indicate if there was a different rate of condensation. The implications of this experiment would be widespread as millions of basidiospores are released into the atmosphere every year. Results indicating that there is a significant effect on condensation and the nucleation of water droplets would indicate that basidiospores could have an effect on weather patterns across large swaths of the planet. Because so many basidiospores are released into the air every year, they could also affect the global climate.

Newtown High School
Tim DeJulio, Teacher

Biatrix Gazaryan

Project #156

Research Proposal, Science, Health and Medical

Cholesterol

In the United States, someone has a heart attack every 34 seconds. Modern medicine blames heart attacks on LDL-C (low density lipoprotein). LDL-C is accused for causing atherosclerosis (clogging of arteries). Atherosclerosis in turn is said to cause CV mortality (cardiovascular death) which includes heart attacks. The purpose of the experiment is to figure out if CV mortality will be more evident in people who have high levels of LDL-C. There will be three cohort groups. The first cohort group will have regular level of LDL (100 mg/dL). The second cohort group will have higher than regular amount of LDL (100mg/dL). The participants will be between the ages of 30 to 70 and will have their initial LDL measured at the beginning of the experiment. In 10 years at the end of the experiment, the data will be collected (including another assessment of LDL). All-cause mortality (death from any cause) will be observed and recorded and the obtainment of cardiovascular disease will also be recorded. If the level of LDL in the blood changes from low LDL to high LDL than the risk of all-cause mortality will not increase and the risk of obtainment of cardiovascular mortality will stay the same. These results can be explained due to the fact that LDL is not a cause factor of atherosclerosis. In fact, LDL binds to and inactivates a broad range of microorganisms and their toxic products. The risk of cardiovascular disease should not rise due to differing levels of LDL because LDL is not a cause factor of atherosclerosis or CV mortality.

Darien High School
Christine Leventhal, Teacher

Devyn Zaminski

Project #157

Completed Project, Engineering, Environmental

Self-Sustaining Biosynthesis of Methane from CO₂ via an Optimized Microbial & Electrochemical Hybrid System

High levels of atmospheric CO₂ brought about by man-made activities are the leading contributor to global warming. Researchers continue to focus on anaerobic digesters (AD) as a means to sequester CO₂ by converting it into CH₄, a valuable fuel resource. Designs of these ADs require costly materials (platinum) to provide high CO₂-conversion performance. Separately, costly expenses associated with wastewater treatment have similarly provided incentive for innovation. Microbial fuel cells (MFCs) predominate these efforts, where wastewater is converted to CO₂, H₂O, and electricity, without energy input. This research converges the wastewater-driven CO₂/electricity production of MFC's with methanogen-driven conversion of CO₂-to-CH₄ in ADs, creating a newly-engineered, self-sustaining integrated bioorganic cell (IBC). A dual-chamber IBC was designed, and separated by a Selemion proton exchange membrane (PEM). Primary influent wastewater (BOD 180mg/L) was inserted into the anodic chamber, where CO₂, electrons, and H⁺ are spontaneously produced. The opposing cathodic chamber is filled with a *Methanosarcina barkeri* culture (~70mg-biomass/200ml). Using linked carbon cloth-based electrodes, the anodic chamber generated CO₂, H⁺ (via PEM), and electrons to fuel cathodic chamber *M. barkeri* reduction of CO₂ to CH₄. The newly engineered, self-sustaining IBC produced two renewable fuels; GC analysis highlighted 1.2L-CH₄ production per gram *M. barkeri* biomass, in 12 days reaction time. This is comparable to the most recent energy intensive AD designs, where external power was needed to create 1.5L-CH₄/g-*M. barkeri*. Concurrently, 0.21L-butane was created in the same time period. Current research aims to increase IBC life span and fuel production through use of alternate DSV membranes.

Greenwich High School
Andrew Bramante, Teacher

Olivia Jones

Project # 158

Research Proposal, Science, Environmental

Climate Changes Effects on the Phenology of Bees

Climate change is causing a rise in temperature. This increase will change the cyclic activity of bees. This could inevitably lead to irreversible changes in ecosystem and possibly the destruction of farming. Researching the exact phenology of different bee species and how over a 135 year span the phenology has shifted parallel to the change in temperature. Bee phenology has shifted according to temperature change. This has caused a drastic drop in bee population species and pollination schedule. This information will predict the future of bee pollination. Which would help to protect the fragile mutualistic relationships that bees are in.

Ridgefield High School
Ryan Gleason, Teacher

Kasey McGerald

Project #159

Research Proposal, Science, Health and Medical

Iron Release From Ferritin When Hecpidin is Present

Does hepcidin inhibit the release of iron from ferritin? Hecpidin is a key regulator of iron metabolism and is usually produced when the body has enough, or too much iron to inhibit the absorption of bodily iron. Iron deficiency is a big problem in the athletic community and scientists have yet to pinpoint the root cause. Hecpidin is known to be produced when inflammation occurs which could suppress the release of iron when the body is in need of it following exercise. Iron will be removed from a ferritin solution using a dilute acid such as dihydroxyfumarate (DHF) to break apart the ferritin protein and liberate the enclosed iron. The iron released can be quantified by spectrophotometry of the Fe(II) complexed with a ligand, ferrozine²⁻. Then, the number of mols of iron per mole of apoferritin will be determined. A hepcidin solution will be placed in some of the ferritin as will there be a control with no hepcidin solution. The total number of atoms will determine the amount of iron released by ferritin. If the ferritin with the hepcidin solution were to release less iron, then it would prove that hepcidin inhibits the release of iron from ferritin. This would mean that athletes have widespread iron deficiency due to the exercise itself and methods to reduce hepcidin production could be tested.

Ridgefield High School
Ryan Gleason, Teacher

Nicole Miller

Project #160

Research Proposal, Science, Behavioral

EEG as a Lie Detector

As of now, there are no accurate lie detectors, and if there were, it could solve problems in court and in the law. The EEG has the potential to show the correlation between brain waves and deception. Reading and researching journal articles about the EEG and about other methods of lie detection. Using the EEG and the GKT test with trained deception to look at the EEGs results with countermeasures. Using the EEG for lie detection using the GKT test could lower the ability for deception to occur during the test, and may result in a more accurate lie detector. In the future, this research can be applied in labs to create a new lie detector that branches off of the EEG and could be used commercially like the polygraph once was.

Ridgefield High School
Ryan Gleason, Teacher

Callie McQuilkin

Project #161

Research Proposal, Science, Environmental

The Effects of Heat Treatment on Microcystis Cyanobacteria

In recent years, cyanobacterial blooms, which produce hepatotoxic and carcinogenic compounds, have dramatically increased in frequency and severity, as a result of fertilizer runoff and rising global temperatures. Current methods of controlling blooms use harsh chemicals that harm the greater ecosystem (i.e.- changing pH and stratification, killing other aquatic organisms). In my experiment, I will test heat treatment as a way of controlling blooms without affecting the surrounding biota. A 2x3 foot floating device, complete with hot plate on the bottom, will be constructed to heat ½ inch of surface water to 60°C. Separate trials will measure the effects of different hot plate temperature settings (19°C, 30°C, 50°C, 60°C, 80°C) on a Microcystis bloom in a fishtank. Changes in the temperature of deeper water (using thermometers at ½, 1, 3, 6, and 12 inches) will also be measured. It is expected that heating surface water to above 60°C will successfully kill Microcystis without having a significant impact on temperatures (less than 10°C change) more than 6 inches below the surface (thus not harming other organisms). Proposed findings are based on a preliminary study about temperatures needed to kill cyanobacterial colonies, as well as literature stating Microcystis' ideal temperature range to be between 25°C and 40°C. If this experiment proves successful, the removal of cyanobacterial blooms—and the destructions of the deadly toxins they contain—will be possible without having adverse effects on other organisms in the aquatic ecosystem. The implications of this research would stretch around the globe, where cyanobacteria threatens the drinking water of millions of people across five continents.

Ridgefield High School
Ryan Gleason, Teacher

Simone Paradis

Project #162

Research Proposal, Science, Behavioral

The Effect of the Knowledge of a Recording Camera on Behavior

Human behavior is affected by others watching, or them being recorded. This is due to wanting a more favorable record of themselves. Humans will try to be more perfect, but in doing this, they focus on the camera instead of the present. This project motivates me because of my decreased ability to complete simple tasks when I am recorded or watched. I am interested to see if these affect others as well. I will approach this with a series of simple experiments, each with two rounds. During a round, participants will be secluded in a room and asked to do an easy task. Round one will have the cameras hidden. During round two, participants will be made aware of the cameras recording their behavior. There will be three series of these rounds. The first series will have a task of throwing a ball into a basket, testing their accuracy count. The second task will be to solve a simple puzzle, testing their time. The third will be four mathematical tests, with tests on single digit multiplication and division, and double digit addition and subtraction, to test time and accuracy. I expect to find that behavior will change in different ways. People will try to be better or kinder, in order to keep their records perfect. On the other hand, focus will stray. Some attention will be on the camera, and ensuring that the camera doesn't record unfavorable actions. General focus on tasks at hand will be decreased due to this. The difference in human behavior when recorded and when not recorded is important in the relevant topic of body cameras on police officers. An officer's behavior may change with the knowledge that their every action is documented. Focus on present problems may stray due to the camera, decreasing the officer's ability to work, or officers will be motivated to be more just and lawful.

Newtown High School
Tim DeJulio, Teacher

Dante Grace Minichetti Project #163

Completed Project, Science, Health and Medical

Targeted Anticancer Properties of Honey Bee Melittin via Cell Surface Lipid Disruption

Chemotherapy continues to play an important role in treating various cancers, however, during course of treatment, it is often difficult to differentiate between cancer and healthy tissue. For normal cells, the aminophospholipid phosphatidylserine (PS) and phosphatidylethanolamine (PE) are predominant in the inner membrane leaflet, and an outer membrane composed of a phosphatidylcholine (PC) lipid bilayer. The outer membrane of a cancer cells, conversely, contains a PE/PS lipid bilayer. Recently, researchers have recently discovered that Paulista wasp venom possesses anti-cancer properties, demonstrating an ability to perforate the cancer cell membrane, based on conjectured selectivity in targeting PS/PE lipids on the surface of the cancer cell. This research investigated this proposed mechanism for cancer cell selectivity by a new and more viable peptide, melittin, found within honey bee venom. To model cells, giant unilamellar vesicles (GUVs) were created via an interdigitated ITO-PET chamber using application of 3V - 2 Hz sinusoidal ac voltage. For simulated cancer cells, GUVs were constructed with 30% PE/PS lipids on the outer membrane, while simulated normal cells contained only 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC). 0.11mM honey bee melittin was introduced to cancer and normal GUV's. Light microscopy highlights melittin's selectivity and ability to disrupt only PE/PS cells, thus providing first-experimental evidence for the peptide's anti-cancer mechanism. Fluorescent microscopy and ATR-FTIR spectroscopy of GUV's after the addition of mellitin provides further evidence for the peptide's selectivity only for cancer cells.

**Greenwich High School
Andy Bramante, Teacher**

Agustina Stefani

Project #164

Completed Project, Science, Environmental

Carbon Capture & Storage via Silver-Catalyzed Hydration of Carbon Dioxide

To reverse the rise in atmospheric CO₂ content, researchers continue to investigate ways to sequester the greenhouse gas in what is known as carbon capture and storage (CCS). In CCS, CO₂ is mineralized to carbonic acid, and later neutralized, however the rate-determining step of this process remains from the hydration of carbon dioxide to carbonic acid. Carbonic anhydrase enzyme can catalyze the reversible hydration of CO₂ to H₂CO₃, however this process is limited by both cost and narrow operating parameters (pH of 7 to 10, at 4-30oC). Bahduri reported the reversible hydration of carbon dioxide, by nickel nanoparticles (NiNPs), in a process that occurs at room temperature, and is pH independent. However, the technology is limited by the toxicity of nickel itself and cannot be used for underground CO₂ sequestration. This research uses biofriendly silver nanoparticles (AgNPs) as a metallic catalyst in the reversible hydration of CO₂ to carbonic acid. 0.07ml/min of CO₂ was bubbled into 1L of deionized water; sequestration of CO₂ to form carbonic acid was measured as a function of pH reduction. For 1L of di-water, pH was lowered in 2 hours from 6.8 to 5.01, corresponding to 0.4 mg of CO₂ sequestered. Similar experiments were separately carried out for 20mg AgNPs and 20mg NiNPs, each suspended in 1L water with 2% PVA. For NiNP's, pH was lowered from 6.8 to 4.44, corresponding to 1.6mg CO₂ sequestered, or 0.08mgCO₂/mg NiNP. Finally, for AgNPs, pH was lowered from 6.8 to 3.85, corresponding to 6.2mg CO₂ sequestered, or 0.31gCO₂/gAgNP.

**Greenwich High School
Andy Bramante, Teacher**

Shobhita Sundaram

Project #165

Completed Project, Engineering, Health and Medical

Detection of Premalignant Pancreatic Cancer via Computational Analysis of Serum Proteomic Profiles

Pancreatic cancer (PC) is currently one of the deadliest cancers, with a 5-year survival rate of just 7%. Just 9% of cases are found while the disease is confined to the pancreas. Discovering the cancer early, which it is still localized, increases the survival rate to 30%, however there are currently no effective tests. This is due to unique characteristics of PC that make it extremely difficult to detect early. In this project, I proposed the development of a computational classification model that can accurately detect premalignant PC from blood data. This data, known as mass spectrometry data, shows which proteins are present in the blood. I used a database of 181 MS samples; 80 were taken from test subjects with PC, 111 were healthy. The first step involved preprocessing the MS data, using non-classical statistical techniques to extract only the data that represented actual proteins, as opposed to data that represents random chemical fragments in the blood. The second stage aims to construct an optimal model through identification of the biomarkers that most greatly impact whether a sample is cancerous or not. The preprocessing and peak detection stage yielded 67 detected peaks from the MS data. I anticipate accuracy far greater than achieved by previous research efforts, and a strong correlation between the identified biomarkers, and proteins characteristic of pancreatic cancer. Detecting PC while it is still localized, particularly at the premalignant stage, allows curative surgical intervention and improves survival chances enormously. While scans cannot detect PC early enough, and biopsies are both costly and invasive, this model provides a low cost, minimally invasive method of detecting premalignant PC from the blood.

Greenwich High School
Andrew Bramante, Teacher

Yohann Britto

Project #166

Research Proposal, Science, Health and Medical

Sports Drinks are Harming to Teeth

The disease dental decay is caused by something called dental plaque which is a bacteria on the tooth surface. This produces acids byproducts of metabolism such as lactate, formate, propionate, and acetate. Since this terrible disease has become very common and can be harmful I want to protect kids from the disease. My goal is find certain drinks can avoid to prevent dental decay. I will be looking at thirteen different kinds of sports drinks and will be testing how adhesive these drinks they are. To do this I will be looking at the the amount of calcium, fluoride, and phosphate along with the concentrations of calcium, phosphate, and fluoride. The higher the concentration the less erosive the drinks will be. All thirteen drinks were slightly acidic but the main difference is that 9 of them have citric acid, this means they are less erosive and have a higher concentration of calcium, fluoride, and phosphate. The other four drinks had lower concentrations of calcium, fluoride, and phosphate making them more acidic. So the drinks that have citric acid and a higher concentration of calcium, fluoride, and phosphate are less erosive. This data shows that all these sports drinks are somewhat acidic and erosive, but if you still want sports drinks the ones with higher concentrations of calcium, fluoride, and phosphate and citric acids should be purchased.

Ridgefield High School
Ryan Gleason, Teacher

Joshua Burns

Project #167

Research Proposal, Engineering, Physical Science

Different material and case design effects on EM drive propellantless thrusters

The purpose of this experiment is to use tests that will measure thrust to discover the best material and shape for the EM propellantless thruster, with a goal of creating a higher thrust to weight ratio. The motivation behind this is to find new ways to increase the thrust output of the drive, in order to increase the potential uses of the thruster, in both atmospheric and exoatmospheric conditions. There will be two tests for each material. One in ambient air, and one in a vacuum chamber. The experimental thruster will be tested on a scale in multiple trials. The first test will use the established brass model as a control, and then different materials and designs will be used. Each new material will be used twice, once in the established design of the thruster, and once in a new design. The expected findings and results will show that different configurations and materials used in the construction of the EM drive will change the performance of the thruster. It is expected that different combinations of materials and shapes will allow for some combinations to increase the thrust observed from the control, and some combinations to provide less thrust. The implications of increasing the thrust of the EM drive are wide ranging. If the thrust is increased even fractionally, it could allow for larger payloads and quicker transit times in space applications. If the thrust is increased greatly, it could be used in planetary operations as well, potentially even completely replacing internal combustion engines in lieu of direct thrust EM drives.

Ridgefield High School
Patrick Hughes, Teacher

Maia Clarkin

Project #168

Research Proposal, Science, Behavioral

The Impact of CpG Depletion via DNA Methylation on the Social Complexity of Insects

Epigenetics is a molecular mechanism that impacts gene expression and works in reaction to an environmental stimuli. Tor genes have been found to be differentially methylated between queens and workers in the species *Apis mellifera* during development, following ingestion of a substance called royal jelly, and therefore it is hypothesized that DNA methylation assists in responding to royal jelly feeding on the molecular level by activating these Tor genes. It is further hypothesized that epigenetic mechanisms play a similar role of distinguishing castes in other social insects. My motivation for conducting this experiment stems from curiosity about the role epigenetics plays in the evolution of sociality and the mechanisms through which gene expression may be altered. 1. Get DNA sequence of the promoter of each gene in the Tor pathway by using NCBI 2. Determine status of DNA methylation in Tor pathway gene promoters either empirically or by prediction. 3. Input the promoter sequence into a software program called MEME that will search for protein binding motifs. 4. Compare the CpG and motif results across multiple species to see if there are molecular features that are present in highly social insects that are absent in simpler insects. Researchers have found that most of the genes in the Tor pathway, the same pathway upregulated by EGFR activation via royalactin, is differentially methylated between queens and workers in the honeybee *Apis mellifera*. The proposed outcome of my experiment is that other eusocial insects, including various bee and ant species in the order hymenoptera, have Tor genes that are differentially methylated between their queen and worker castes.

Ridgefield High School
Ryan Gleason, Teacher

Luca Barcelo

Project #169

Completed Project, Engineering, Environmental

Crowd-Sourced Detection and Mapping of Nitrate Water Pollutants via Mobile Web-Based Image Analysis System

Nitrate pollution is a serious contemporary problem. Many fertilizers and plant conditioning products utilize high quantities of nitrates, which runoff into surrounding bodies of water with subsequent rainfall. This runoff of artificial nutrients triggers an ecosystem response that often leads to unwanted growth of organisms in a process known as eutrophication. Via an over production of phytoplankton blooms, for example, dissolved oxygen levels rise during the day, but fall at night due to increased levels of respiration. When DO levels fall significantly, the aquatic ecosystem is out of balance, and biotic factors within the ecosystem begin to suffocate. The reason to create a crowd-sourced detection method comes from the essential fact that conventional methods rely on large and expensive devices, which are submerged at a few points along the given body of water's area. This detection method serves to be impractical for the rapid and wide scale detection necessary in combating nitrate pollution. To combat hypoxia effectively, a crowd-sourcing detection method for the detection of unwanted increases of nitrates is essential, so that the given body of water can be treated accordingly. Using colorimetric detection of NO_3^- in solution via the Salifert NO_3 Profi test, two reagents are added to an aliquot of contaminated water. Solution color of the possible-contaminated samples is determined via mobile camera-based image analysis, and compared to a non-contaminated blank, as well as regression data for the same analysis at 540 nm, so that Nitrate levels (in ppm) can be correlated to visual solution color. This Nitrate data is then will be shared via server, to create a current and inexpensive crowd-sourced database for water contamination.

Greenwich High School
Andrew Bramante, Teacher

Rebecca Cohen

Project #170

Research Proposal, Science, Environmental

The Effect of Lionfish Control Programs

Invasive species are a danger to the biodiversity of the world. However, The United States of America is extremely behind on taking action on this issue. The Indo-Pacific Lionfish, especially the *P. volitans* variation native to Indo Pacific regions, decreases the biomass of native fish by disrupting ecosystems. In two different locations in Florida, the abundance of lionfish would be measured before and after implementing a lionfish informational program for these fishermen in one of the locations, and not implementing the program in the other location and using local divers to count the abundance of lionfish in both locations before and after. It is hypothesized that the lionfish numbers would decrease in the location where the informational program was implemented due to increases in fishing for these species rather than native ones, therefore reducing the invasive impact of this species in Florida. This experiment could be used to show the usefulness of lionfish control programs, such as informational programs which would in turn conserve more native species and encourage healthy ecosystems.

Ridgefield High School
Patrick Hughes, Teacher

Sophia Chow

Project #171

Completed Project, Science, Health and Medical

PDE-4 Inhibitor-Assisted Antibiotic Suppression of *Borrelia* Biofilm Growth for Treatment of Chronic Lyme

Patients with Lyme disease rely heavily on antibiotics for treatment against chronic symptoms associated with *Borrelia burgdorferi* (Bb) infection. If not detected at an early stage, Bb adheres to internal surfaces, producing an extracellular polysaccharide, or biofilm, which prevents antibiotics from reaching the bacteria. *B.turcica*-IST7(Bt) was used as a less hazardous, yet morphologically similar organism. Bt was cultured in 2-3% Agarose (BSK-H/6% rabbit serum) for 10 days, and then subjected to separate 10ml aliquots of saturated aqueous solutions of PDE-4 candidates Rolipram (1.29mM), Cilomilast (2.9mM), and Roflumilast (72mM). SEM analysis is ongoing, and will be used to determine PDE-4s ability to inhibit growth of Bt biofilm, so that it may be used as an effective treatment for onset and chronic Lyme borreliosis. ImageJ analysis of SEM images of *B. turcica* biofilms, where Rolipram, Roflumilast, and Cilomilast were added, highlight a 31.7%, 20.3%, and 1.6% reduction in biofilm growth and consistency, respectively, when compared to *B. turcica* biofilms where no PDE-4 inhibitors were added. These results shed light on a new, PDE-4 based regime of Lyme treatment, that when used in conjunction with antibiotics, may increase the effectiveness for eliminating spirochete and roundbody forms of *Borrelia*. PDE-4 inhibitors were effective at reducing the growth and consistency of actively growing and healthy *B. turcica* biofilms after 1 week of drug administration. The addition of mM concentrations of PDE-4 inhibitors effectively suppressed/disrupted *B. turcica* biofilm growth by 1.6% for Cilomilast, 20.3%

for Roflumilast, and 31.7% for Rolipram. Patient treatment with PDE-4 inhibitors, prior to administration of antibiotics, may increase accessibility to *Borrelia* spirochete and roundbody forms, thereby increasing the antibiotic's overall effectiveness.

Greenwich High School
Andrew Bramante, Teacher

Connor Li

Project #172

Completed Project, Engineering, Physical Science

Fabrication of a Magnetically Vertical-Aligned Boron Nitride Nanotube Membrane in a Lyotropic Precursor for Water Transport Applications

Boron nitride nanotubes (BNNTs) have very promising applications in water transport, namely filtration and osmotic power. The problem is that making a fluid exchange membrane containing enough transmembrane BNNTs to be useful and practical in water transport applications is very difficult and expensive, only achievable in small-scale lab environments. This research designed a process to perform widespread-alignment of BNNTs in a polymer membrane that is practical and scalable, utilizing the diamagnetic, self-assembling properties of cylindrical micelles containing sequestered BNNTs in a lyotropic liquid crystalline precursor. This lowers the magnetic field requirement of alignment to 1 T, using an annealing process to produce a membrane of varying size. Orientation of the finished aligned nanocomposite was determined via polarized Raman spectroscopy. BNNTs contained within the polymer nanocomposite membrane were successfully vertically aligned as evidenced by polarized Raman spectroscopy. This supports the engineering goal of creating a practical, facile, and scalable process that was successfully developed to perform widespread, uniform characterization of BNNTs in a polymer membrane. Due to the success, additional research is being done with molecular dynamics software to determine the rate of flow of the prototype membrane. The successful development of this process opens possibilities for the application of the unique nanofluidic properties of BNNTs in osmotic power systems and advanced semipermeable membranes used for filtration. They possess a water flux 10x greater than conventional existing filtration membranes, and can harvest energy from a salinity gradient with efficiencies exceeding 1000x that of the conventional pressure driven counterpart. This research makes another step toward making these properties applicable.

Greenwich High School
Andrew Bramante, Teacher

Krista Panageas

Project #173

Research Proposal, Science, Health and Medical

Using Bioluminescence Resonance Energy Transfer to Visualize and Identify Lyme Disease Antibody Interaction

Bioluminescence resonance energy transfer (BRET) is a method of visualizing protein interactions using light emitted from bioluminescent molecules. It is noninvasive, sensitive, and effective in vivo, which is beneficial in observing the proximity and interaction of the Lyme disease antibodies and antigens. The BRET system has the ability to provide an improved understanding of the function of antibodies; therefore, leading to the development of methods for detection, drug targeting, or the creation of a vaccine to prevent Lyme disease. Lyme disease antibodies and antigens will be put in a clear solution as the control, compared to a blood sample which contains Lyme disease. A fluorescent linker will be used to attach the luminescent donor and acceptor, Renilla Luciferase and Green Fluorescent Protein to the antibody. The system will be used as a biosensor; when the antibody exhibits a change there will be a shift in the light emitted. It is expected that there will be a significant change in the light emission in the clear and blood solutions. The light emission will be observed under a microscope and UV lamp. A scanning spectrometer will be used to collect quantitative data on the change in emission. The interaction between the antibody and antigen and how they interact will be illuminated. The signal will be weaker in the blood sample due to its pigmentation, however it will be strong enough to show change, meaning it could be used as a method of detection. These findings have many potential applications for the future, the BRET system could be further developed and marketed as a method to detect disease in the bloodstream. Also knowledge on the way the antibodies interact with the antigen could help further researchers in finding ways to copy the antibody structure in order to create new drugs or vaccinations.

Ridgefield High School
Ryan Gleason, Teacher

William Yin

Project #174

Completed Project, Engineering, Health and Medical

Cost-Effective, Portable Paper-Based Diagnosis of Alzheimer's Disease: Targeting A β Oligomers Using Curcumin-PLGA-Ceria Nanoconjugates as Artificial Biomarkers

Over 35 million individuals around the world suffer from Alzheimer's disease, and the number is expected to more than double over the coming years. However, Alzheimer's is often only first diagnosed after recognition of external symptoms, by which time a considerable degree of irreparable brain damage has already been inflicted upon the brain. Additionally, current clinical methods for the early diagnosis of Alzheimer's disease tend to be costly and time-consuming. My experimentation involves the synthesis of artificial biomarkers (curcumin-PLGA-ceria-nanoparticle conjugates, or CPCNCs) which selectively bind to A β oligomers, as well as a bioactive-paper-based sensor to act as the colorimetric biosensor. Testing of the biosensor would involve exposing the bioactive paper to a solution of CPCNCs with either A β monomers or oligomers; the resulting color of the paper would reveal its detection of oligomers (which are indicative of early Alzheimer's development). A paper-based biosensor will be developed for the cost-effective, readily-accessible diagnosis of Alzheimer's disease. Patients who wish to test for Alzheimer's would ingest the biocompatible artificial biomarkers and would then place a serum sample upon the sensor surface. A color change on the sensor would suggest the presence of Ceria nanoparticles (released by CPCNCs upon conjugation with A β oligomers), thus indicating the presence of Alzheimer's disease. This biosensor would potentially change the face of Alzheimer's disease detection and save many lives, allowing those individuals living in low-income communities or third-world countries to gain access to a readily-accessible early diagnostic test for Alzheimer's. The biosensor would allow for self-diagnosis without the assistance of a medical professional, permitting many more individuals to easily detect the presence of Alzheimer's so that they may seek therapy or treatment.

Greenwich High School
Andrew Bramante, Teacher

Ashley Carnes

Project #176

Research Proposal, Science, Behavioral

Snake population Count

I will be taking snake population count in the greater Newtown area. I want to see how many snakes live in this area and how people may be affecting the growth of snake population. How the area is affected by people will also be taken into an account. For an example, if there's a lot of human activity near that area. I will search at state parks in my area to search for snakes and I will record how many I find in that specific area over an hour or two and will check those places once a week over the duration of 2 months. Each time a snake is found the place of which it was spotted will be recorded of a map of the area. The breed and gender of the snake will also be recorded if it's possible to find those variables. I hope to find that the snake population is unaffected by the people and the area they're in. The conclusion I wish to get is an even snake population count indicating that there's a balance in the ecosystem.

Newtown High School
Timothy DeJulio, Teacher

Mary Carlo

Project #177

Research Proposal, Science, Health and Medical

Effects of Delayed and Immediate Recovery Time Following a Concussion

Concussions are one of the most common, dangerous, and potentially deadly injuries which an athlete can sustain in play. A mild traumatic brain injury, concussions are caused by neural cell death after the brain comes into contact with the skull. Recent studies have shown that the longer and more concentrated recovery time is for athletes after suffering a blow to the head, regardless of age, the more positive the results and the increased chance for an almost complete recovery. The data will be obtained from a group of collegiate football players. The athletes will be grouped based on return to sport. Immediate, in season return, and a delayed return group, in which the athletes return after the season is over. Several variables will be measured: demographics, socioeconomic status, medical history, and athletic performance before and after the concussion. The control group will be collegiate athletes without concussions. The results are expected to support the delayed return to concussion group. Other studies have proven that the longer athletes wait before returning to the game, the chance of obtaining a degenerative disorder later in life, such as Chronic Traumatic Encephalopathy, a common neural loss disorder in former athletes which leads to premature death, decreases significantly. Typically, athletes who partake in contact sports are the most prone to get a concussion- with each blow to the head causing further brain damage, which can be detrimental to other bodily functions. This study is pertinent because a high proportion of children play contact sports and of these, 75% of them will suffer from a concussion, potentially multiple times. Many make their conditions worse by not having a proper break from play.

Darien High School
Christine Leventhal, Teacher

Nima Gurung

Project #178

Research Proposal, Science, Physical Science

The effect of a Turboelectric Distributed Propulsion system on a hybrid-wing-body aircraft

The primary goals of future aircraft designs are to reduce fuel burn, emissions, noise and field length. The Turboelectric Distributed Propulsion (TeDP) system is a proposed design aimed to achieve these goals. This research would conduct an in depth study on the effects of the TeDP implementation in a hybrid-wing-body aircraft in order to determine it's viability as a functional design that is also able to meet the set goals. A hybrid-wing-body aircraft would be chosen as the baseline aircraft for this study and a TeDP system would be installed in it. The vehicle would go through different flight conditions to examine the system's effect on the aircraft. The HWB aircraft combined with the TeDP system will be able to reach the goal of 70% less fuel burn without any configurations to the other systems inside the aircraft. An increase in performance will also be noted contributed by the decrease in weight. This would also negatively affect the fuel burn resulting in a positive effect on the environment. The TePD installation would have an overall positive implication. It will not be able to reach the goals set fully, however it will be closer to the goals than current state-of-the-art aircrafts. It will improve aircraft efficiency and have a positive effect on the environment.

Ridgefield High School
Patrick Hughes, Teacher

Catherine Li

Project #179

Research Proposal, Science, Health and Medical

The Effects of Phytochemicals on Autophagy in Rats

Aging is an inevitable process, accompanied with increased risk for chronic diseases. There is growing evidence indicating intake of phytochemicals, natural plant compounds, is associated with reduction in risk of chronic disease through their antioxidation, anti-inflammation, anti-carcinogenesis, and anti-aging properties. The overall objective of this project is to investigate the impact in rats of gallic acid, curcumin, quercetin, spermidine, and their combination on autophagy in tissues and cognitive capacity. Young and old rats will be treated with varying concentrations of phytochemicals. They will be sacrificed, and their pancreas harvested. Using liquid nitrogen to grind up the pancreas, protein will be extracted using centrifugation. BCA protein assay will compare protein concentration in the pancreas with the protein standard of albumin. Gel electrophoresis and western blot assays will be conducted as well to observe and analyze proteins. All individual phytochemicals will manage to increase the efficiency on autophagy in both young and old rats. BCA protein assays, gel electrophoresis, and western blot assays will support the effects of the substances on protein concentrations in the rat pancreas. Overall, the combination of gallic acid, curcumin, quercetin, and spermidine will create synergy and will display a much more effective treatment on autophagy. This research will shed more light on the importance of nutrition and the significance of autophagy. Natural alternative approaches have great potential to combat the adverse side effects of aggressive disease treatments. Phytochemicals are especially promising because they can target multiple areas, are generally less toxic, and cheaper. The results of this study may contribute to the possible development of novel therapies that can better target cells using the co-administration method.

Ridgefield High School
Ryan Gleason, Teacher

Nora Maerean

Project #180

Research Proposal, Science, Behavioral

Analyzing Rhythmic Processing Abilities in Children Ages Five to Fifteen

Dyslexia is a language disorder characterized by difficulty reading and deficits in rhythmic processing abilities. Rhythmic or musical based therapies have been proposed to improve reading abilities. First it is important to see whether there is a correlation between good rhythmic and language processing abilities in non-dyslexic children. My research is the first step in determining this correlation. I will look at rhythmic processing abilities in a group of children. In order to do this, I will use the Beat Alignment Test (BAT), a test that examines a person's ability to detect and perceive rhythm in three sub-tests. In each sub-test, participants will take part in a series of rhythmic tasks that examine rhythmic perception and synchronization by tapping to an excerpt of music. I will use AUDACITY to record tap times and PRAAT to analyze the recordings. Overall my expectation is that the general population of children who do not have dyslexia will perform well on these tasks. Within this, however, I predict that older children will have a better ability to detect rhythm. In addition, children with more exposure to rhythmic or musical activities will show slightly better results, because exposure to rhythmic or musical activities will improve rhythmic processing abilities. My research will establish baseline data for future studies done in this field. A next step is analyzing reading and language abilities in the same participants to see whether there is a correlation between performance on rhythmic and reading tasks, and experience in rhythmic or music related activities. Future studies must look at whether these activities done over long periods of time will be beneficial to dyslexic children.

Ridgefield High School
Ryan Gleason, Teacher

Lucy Briody

Project #181

Completed Project, Science, Environmental

Plastic Ingestion in Pelagic Sportfish

This study seeks to quantify the plastic ingestion rates in fish of this area and serve as a comparison to both gyres and coastal systems. To complete this, stomach dissections of 158 fish from a variety of species were taken and their results were analyzed to provide further insight into the health of this system. This study will contribute to the pressing question: "What factors contribute to varying ingestion rates?" The fish sampled were Atlantic flying fish, Barracuda, Tuna, Kingfish, Mahi Mahi, and Wahoo. The fish were defrosted in a water filled bucket before the dissection process began. The stomach contents was poured into a clear bucket, which was then poured into a multi-layer sieve. Each level of the sieve was examined separately using a pair of tweezers. Pieces of plastic were removed and saved to be later analyzed. Overall, 42.41% of the fish sampled had ingested plastic. While Atlantic Flying Fish, Barracuda, and Kingfish all had too small of sample sizes to be considered significant on their own, it is clear that there is ingestion within these species and that they need to be examined further. Mahi Mahi, which had the largest sample sizes of any of the species studied, had an ingestion rate of 35.05%. This study indicates that location is an important factor in determining ingestion rates. On a smaller scale, the ingestion of plastic could potentially lead to adverse effects for each individual organism and the species as a whole. Furthermore, humans could be affected by their ingestion of fish containing plastic. Further research must be conducted to determine the effect of plastic on fish and the humans that consume them.

Ridgefield High School
Patrick Hughes, Teacher

Ari Singer-Freeman

Project #182

Completed Project, Science, Environmental

The effects of elevated atmospheric carbon dioxide on body size in *Drosophila melanogaster*

Global climate change is causing rapid alterations in the abiotic factors in ecosystems, such as atmospheric carbon dioxide levels, precipitation levels, and temperature levels. These altered conditions are forcing populations to adapt at a faster rate than ever before in recent history. In order to understand the nature of populations in the near future it is critical to understand the responses of these populations. Previous studies have shown that increased temperature causes a decrease in body size in *Drosophila melanogaster*. In this study, the effects of elevated atmospheric carbon dioxide levels on body size were examined, in order to understand more fully the effects of climate change on *Drosophila*. Flies were cultured in vials containing either 400 ppm or 800 ppm carbon dioxide, and were harvested after they reached maturity. After the flies were sacrificed, one wing was extracted from each fly. These wings were photographed using a Nikon Eclipse E200 microscope at 40x magnification, and the wing length was measured using ImageJ. It was hypothesized that if atmospheric carbon dioxide levels are elevated, then the *Drosophila* should grow to have an increased body size because of increased transposon activity. No statistically significant correlation was observed between atmospheric carbon dioxide level and body size, however, an unexpected association was found between carbon dioxide level and variation in wing length. These results could lead to a better understanding of epigenetic response to stress, because the same correlation between wing size and cell density has been observed in epigenetic response to other variables, such as temperature.

Darien High School
David Lewis, Teacher

Paul Hager

Project #183

Research Proposal, Science, Health and Medical

Regulatory miRNA Responses to shRNA-mediated Knockdown of PLEKHA7, a Novel Agent in Tumor Suppression, in Various Endothelial and Epithelial Cell Types

Cancer caused over seven million deaths in 2015. While treatment has become increasingly effective in recent years, reliable diagnostic and interventional options remain elusive. The proposed research aims to compare how the loss of PLEKHA7, an adherens junctional binding protein in epithelial and endothelial cells, impacts the concentrations of cell-regulating microRNAs (miRNAs) in various cell types. PLEKHA7 is lost early in cancer progression in these cells, and that loss has been implicated in cell cycle deregulation and anchorage-independent growth (AIG), two hallmarks of cancer. Concomitant loss of PLEKHA7 and changes in the concentration of important regulatory miRNAs has been observed in one cell line (Caco2), but this correlation has not yet been established in different types of epithelial and endothelial cells. Therefore, this research aims to compare the effects of PLEKHA7 knockdown (via in vitro shRNA-directed RNA interference) on regulatory miRNA concentrations in cultured cells of those two tissue types from various organs, in different stages of cancer progression. These cell types would include cultures of primary and cell-line kidney, mammary, and colorectal cells, which are involved in some of the most prevalent types of cancer. It is hypothesized that, if shRNA-mediated knockdown of PLEKHA7 is carried out in various types of primary and cell-line epithelial and endothelial cells, changes in the concentration of regulatory miRNAs will be similar to those seen in Caco2 cells due to the fairly standardized role of PLEKHA7 in cell junctions. If the effects observed in Caco2 cells are approximated in the other cell types tested, further support for the development of miRNA-directed therapies will be established, and a key step in endothelial/epithelial (including breast, colorectal, and kidney) cancer progression will be better elucidated.

Darien High School
Christine Leventhal, Teacher

John Lochtefeld

Project #184

Research Proposal, Science, Health and Medical

Treatment for Telomere Loss Using Androgen Therapy

Telomere loss is what enables the body to physically age. Androgen therapy is expected to have an effect on reversing telomere reduction in mutations because male hormones have been successful in the elongation of leukocyte telomere. Mutations of telomere deficiency, consist of telomere reverse transcriptase (TERT), telomere RNA component (TERC), dyskeratosis congenita 1 (DKC1), and regulator of elongation helicase 1 (RTEL1). These mutations all relate to having a deficiency in telomere base pairs in their host compared to normal humans. The purpose of this study is to determine whether using androgen therapy in male hormones, specifically Danazol, can prevent telomere loss in subjects with telomere mutations. It is expected that the telomere deficiency in the subjects will be decreased with Danazol therapy. 26 randomly selected individuals over the age four who suffer from a telomere mutation will be given 600 mg of Danazol twice per day over 18 months. All subjects will receive baseline testing at the beginning and end of the experiment and will be screened at the 4, 8, and 12 month period to look for improvement in telomere count. The progress will be measured by collecting DNA from the subjects using an automated Maxwell 16 Instrument. Telomere length will be determined by analyzing the DNA using a Thermal Cycler (Polymerase Chain Reaction Machine). In subjects treated with Danazol, an expected increase of 35% in telomere base pairs from the start of the experiment to the end is present. The significance of this experiment hopes to find a valid way to suppress the effects of telomere mutations and in the process decrease the likelihood of individuals developing other conditions that often accompany such mutations.

Darien High School
David Lewis, Teacher

Kelsey Vrooman

Project #185

Research Proposal, Science, Health and Medical

The Short Term Effects of Methamphetamine Hydrochloride on the Brain's Structure and Defense System

Approximately 10.4 people in the United States ages twelve and above have ingested methamphetamine (MA). In the brain, MA penetrates neurons, causing there to be a release of a multitude of dopamine, resulting in severe mood swings and psychotic behavior. The proposed study investigates the initial changes and microglial activation in the brain under the influence of methamphetamine hydrochloride (MAHC). To conduct this experiment, rats will be randomly split into three groups and injected with MAHC twice daily for 2 weeks. The control group will be injected with saline. the LD group will receive 4 milligrams of MAHC per kilogram, and the HD group will receive 8 milligrams of MAHC per kilogram. The rats' brains will then be scanned under a 3D MRI to measure brain volumes. [³HPK 11195] in vitro autoradiography will be performed on the frozen brains into three groups and injected with MAHC twice daily for 2 weeks. The control group will be injected with saline. the LD group will receive 4 milligrams of MAHC per kilogram, and the HD group will receive 8 milligrams of MAHC per kilogram. The rats' brains will then be scanned under a 3D MRI to measure brain volumes. [³HPK 11195] in vitro autoradiography will be performed on the frozen brains to measure microglia activation. [³HPK 11195] is a translocator protein found in microglial cells that function is to locate and bind to benzodiazepine, which is found in MA. MA also inhabits radioactive particles that autoradiography can photograph, showing where MA and therefore where microglial cells travel. The predicted results are that the second and third group are going to have enlarged striatal volumes and display [³HPK 11195] binding in the striatum. This is because the striatum receives and processes dopamine, which explains the psychotic behavior that comes with using MA. These findings will assist in proving that the striatum is affected by MA before any other brain system, helping scientists further understand the mystery of addiction and how to treat it.

Darien High School
Christine Leventhal, Teacher

Johnathan Stimpson

Project #186

Completed Project, Science, Behavioral

The Effect of Changes in the Stock Market on Polling of Incumbent Presidential Candidates Using Time Series Analysis

This study seeks to address the “Socioeconomic Theory,” a hypothesis that holds: A.) stock market performance influences, or is at least correlated with, voting behavior in presidential elections; and, B.) voters reward the incumbent administration for positive increases, whereas voters penalize it for negative trends. Previous studies investigating these conjectures have found an association between yearly stock market trends and performance of incumbent administrations. s have found an association between yearly stock market trends and performance of incumbent administrations. Building on this scholarship, this study seeks to see if the association still persists from a more granular perspective. This study does so by comparing the daily closing price of the Dow Jones with the daily adjusted polling average of the incumbent presidential candidate in the 250 days before election day. The scope of the study was limited to the elections of 2004, 2008, and 2012, the most recent years where regular, daily polling information was available. After performing requisite preparations, the Granger Causality model, a form of linear regression that seeks to correlate two time-series by regressing past values of one on future values of another, was employed for all three years. The model, however, found no association, even when each year was broken down into shorter time intervals. Two other time-series models, ARIMA and VAR, confirmed these findings. While these results appear to reject a possible link, the unreliability of political polls raises the possibility that noise obscured a potential signal. Moreover, this study did not stratify the data by potentially exogenous variables, such as media exposure, level of education, and geography. Further research using different methodology or more fully taking into account exogeneity is necessary in order to reach a more robust conclusion.

Darien High School
Christine Leventhal, Teacher

Elizabeth Borecki

Project #187

Research Proposal, Engineering, Health and Medical

hearing loss? ... Hearing Loss?!!

There is an increase in hearing loss due to the use of personal listening devices with technology. A main component of the hearing loss is earbuds with smartphones. The common person is not aware of this. Once the damage to the hearing is caused, it is mostly irreversible. Use the device itself to deter the user from hearing loss, by building an app that works on all platforms. The app would track a user's hearing to a certain degree of accuracy. The app would track the use of earbuds, headphones, or speakers to play audio. The app would track the volume level over time. The app would incorporate a game feature where the user can earn points and prizes. There would be a database that stores the data from all the users. The predicted findings are, with the app, the general public will become more aware of the hearing loss and of their auditory system in general. Hearing loss in users, those who use earbuds to hear audio, may be reduced. Additionally, the listening devices industry may reconsider the effect of their earbuds and headphones.

Darien High School
Jeromy Nelson, Teacher

Steven Ma**Project #188**

Completed Project, Science, Physical Science

Reliably Jammed Disk Packing: A Novel Feature of a Classic Geometry Problem

The packing problem is a classic geometry problem dating back to the 17th century. In the project, we are studying the novel feature of reliably jammed packing, meaning that the packing is still jammed even if several disks are removed. I developed a passion for mathematics by participating in math competitions. I thoroughly enjoyed the experience and decided to branch out into math research to discover new ideas and concepts. All of the research done is math based and thus only requires paper and a computer. The problems are solved by using mathematical proofs. The project is completely safe and does not require any hazardous materials. In our project, we discovered that there are certain packings that remained jammed even after removing many disks. In addition, we studied lattice packings of disks, where we found precisely one packing that remained jammed after removing a disk. We also discovered that in certain cases, removing disks may only unjam a few other disks while the vast majority of disks remain jammed. The study of reliably jammed packing configurations is useful to the packing of shipping boxes, as a reliably jammed packing of disks allows for the packing to be stable even if some of the packing material breaks. Some of the packings we discovered remain completely jammed and rigid even if many disks break or are removed.

Greenwich High School
Andrew Bramante, Teacher

Danya Jafri**Project #189**

Research Proposal, Science, Health and Medical

A Trend of Protein Expression in Differentiating Takotsubo Cardiomyopathy from an Acute Myocardial Infarction

The purpose of this research is to identify cardiac biomarkers, specifically protein expression, that will aid in the differentiation between takotsubo cardiomyopathy (TTC) and myocardial infarction (MI). Endothelin-1 and Troponin are key cardiac biomarkers (proteins) that are expressed at different levels in cardiac events and thus a higher expression of these proteins are prevalent in myocardial infarctions. Prior to this research, patients with takotsubo were often misdiagnosed and continued to require invasive procedures to develop a diagnosis and prognosis. Previous work on this condition has failed to distinguish its characteristics from those of a myocardial infarction. It is hypothesized that Endothelin-1 and Troponin levels would either be augmented or have a lower regulation in TTC patients, indicative of their role in diagnosis of takotsubo cardiomyopathy and its distinction from MI. This experiment entails centrifugation of blood samples and analyzation of protein expression in the blood plasma by use of assays and microarrays, biological medias used to identify and sequence proteins. It is projected that Endothelin-1 levels are bound to be slightly augmented in the study, possibly indicative of its role in the pathogenesis, or development, of takotsubo cardiomyopathy, and that troponin levels will be slightly upregulated in myocardial infarction patients. This research will not only prevent misdiagnosis of takotsubo cardiomyopathy, but also provide an expanded horizon for further research in the field of cardiac biomarkers in similar indistinguishable conditions. Protein analysis is key in the diagnosis of not only cardiac conditions, but also pulmonary and neurological conditions, and is a key diagnostic tool for the differentiation of the etiology, or originations, of diseases.

Darien High School
Christine Leventhal, Teacher

John Goll

Project #190

Research Proposal, Science, Environmental

The Effect of Environmental Changes on Horseshoe Crabs in Correlation to Red Knot Migration

The North American Horseshoe Crab, *Limulus polyphemus*, is indigenous to North America and is considered a key species ecologically and, in modern industry, such as the use of their blood as a medical indicator. Horseshoe Crabs play a large role in the migration of many seabirds, who rely on horseshoe crab eggs; this is because horseshoe crabs rely on the shore mainly to reproduce and feed. The objective of this experiment is to determine the effect of environmental changes, such as water temperature and overfishing on the horseshoe crab population, which will be measured in correlation with the red knot shorebirds migration. To effectively estimate the population size horseshoe crabs in a given area, a technique called “capture recapture” model will be used in the Delaware Bay, which is a temporary habitat for the Redknot on their migration north. The Horseshoe crab population has shown a large decline in population size in the past years due to reduction of their habitat, increased water temperatures, and overfishing in the Delaware Bay. Overfishing has also impacted the Red Knot, a shore bird species, who frequenting the same shoreline habitat as horseshoe crabs. Developing a management plan to regulate horseshoe crab harvesting would greatly improve their population size as well as local shorebirds who rely on them for a source of food. Future work would be in quantifying the environmental changes in the Delaware Bay and the human impacts, which greatly affect the horseshoe crabs reproductive ability.

Darien High School
Guy Pratt, Teacher

Taylor Richards

Project #191

Research Proposal, Science, Health and Medical

The Effect of Gender on Magnitude and Persistence of Cerebral White Matter Structural Alteration after Sports-Related Repetitive Head Impacts.

Repetitive head impacts (RHI) are thought to be necessary for the long term development of chronic traumatic encephalopathy (CTE), a neurodegenerative disease characterized by a variety of macroscopic defects, most significantly including structural alteration and atrophy of white matter (WM). However, the exact pathology by which RHI causes CTE is not known, nor has any research been done looking at how this pathology is related to gender. The objective of this study is to determine if there are any differences in the changes of WM and longevity of these changes due to RHI between males and females. Thirty subjects between the ages of 18 and 24, ten female hockey players, ten male hockey players, and five male and five female non-athlete controls, will undergo Diffusion Tensor Imaging (DTI) at pre-season, post-season, and after 6-months of no-contact rest to determine magnitude and persistence of WM changes. DTI is an imaging modality capable of deriving white matter structures based off diffusion patterns. Head impacts will be measured using helmet mounted accelerometers. The projected results for this experiment are that both male and female athletes will experience greater changes in WM from Time 1 to Time 2 than the control group, and that a high percentage of these changes will still be evident from Time 2 - Time 3. As compared to male athletes, female athletes will have considerably greater structural alteration in WM as determined from DTI metrics, however the same percentage of these alterations will be transient. This research will be beneficial in providing needed information regarding the development of CTE in females, potentially leading to new methods and future avenues of research to prevent this debilitating disease.

Darien High School
Guy Pratt, Teacher

Will Wilson

Project #192

Research Proposal, Science, Health and Medical

Calcium Blocker Therapy in combination with Anti-CD3 and Anti-CD20 prevents and reverses Type One Diabetes in NOD mice

Diabetes is an autoimmune disease characterized by the selective destruction of insulin-producing beta cells. The disease affects approximately 1.25 million Americans and is growing at a rapid pace. This experiment involves using a calcium channel blocker specifically verapamil, to block calcium channels at the TXNIP promoter. Anti-CD3 will suppress the immune response from auto-aggressive T cells, while Anti-CD20 will do the same to B cells. Verapamil will be administered orally through the mice's water, while the antibodies will be administered intraperitoneally with a syringe. A measurement of blood glucose levels of the mice will be made at scheduled daily intervals to monitor the efficacy of the treatment. Western Blot tests and Real Time Polymerase Chain Reaction will also be used to measure TXNIP expression and insulin levels. The results of the experiment should show a decline in TXNIP expression and beta-cell death resulting in increased beta cell mass, a retention of insulin levels, and a decline in blood glucose levels. The results will encourage further research into this promising area of treatment and hopefully lead to further breakthroughs. With the rate of Type One Diabetes increasing every year, these breakthroughs are needed.

Darien High School
Christine Leventhal, Teacher

Courtney Lowe

Project #193

Completed Project, Science, Environmental

Efficacy of Azolla Fern in Absorption of Nutrients from Simulated Gray Water

Nutrient saturated water released from water treatment plants on the Connecticut coastline, overwhelmed during major rainfall events, leads to excessive algae growth that results in dangerous hypoxic conditions in Long Island Sound. Mitigating the negative effects of wastewater is possible through utilization of natural bioremediators in tangent with treatment plants. The *Azolla caroliniana* fern is an effective bioremediator, with high absorption capability and fast growth rate due to its symbiotic relationship with cyanobacteria. To increase use of systems featuring aquatic plants to decrease algae blooms, this experiment utilized three-section treatment systems to discover the correlation between the density of *A. caroliniana* exposed to the nutrient rich wastewater and the absorption of nutrients. Simulated wastewater, containing measured concentrations of nutrients, nitrates and phosphates, were dripped from a distribution bucket into a single tub of cultivated ferns, a measured density of $.204 \text{ g/m}^3$ of *A. caroliniana*. Processed water was then pumped into a separate tub where concentrations of pollutants will be recorded. Separate trials were conducted increasing the density of *A. caroliniana* to $.408 \text{ g/m}^3$ and to $.612 \text{ g/m}^3$, by using 2 tubs and 3 tubs in the treatment systems. The greatest absorption of waste was observed in the system using 3 tubs providing the greatest exposure to *A. caroliniana*. Margins of uncertainty indicated the only significant change of absorption between the systems containing 2 tubs to 3 tubs of *A. caroliniana*. Such findings insinuate that another factor, beyond the density of *A. caroliniana*, is affecting the ferns ability to absorb nutrients. This study supported that the *A. caroliniana* removes nutrients that cause algal blooms, but further research is needed to fully understand the factors that affect absorption.

Darien High School
Guy Pratt, Teacher

Escher Campanella

Project #195

Completed Project, Engineering, Physical Science

A Radio Transceiver-Based Wearable Device to Help Visually Impaired Users Avoid Vehicles

With the increased use of quiet electric cars, crossing the street is becoming dangerous for visually impaired (VI) people. Current methods used to cross the street such as hearing, white canes, and guide dogs are becoming unreliable due to this. To address and solve this problem, a radio transceiver based wearable device has been developed. It will warn users crossing the street by bouncing radio waves off of any approaching vehicles. To sense metal objects, the device has a low-cost but modern radio transmitter and receiver. Each wave has a unique variable coded into it. If the same number value of this variable is received two times on the receiving end, this will indicate that a radio wave bounced off of metal. If one copy of it is received, it did not. When the device was in the presence of metal, the second copy of the variable was received at random times. The type and occurrence of the waves were not frequent enough to support a conclusion though. I believe this happened because the frequency of the transmitter used (2.4 GHz) was not high enough to complete a radar transmission. In the future, if a higher frequency radio transceiver is implemented, the device will successfully sense surrounding metal objects and warn users of dangerous situations.

Darien High School
David Lewis, Teacher

Elizabeth Corney

Project #196

Research Proposal, Science, Health and Medical

Different Blood Types in relation to frequency of Pulmonary Embolisms in Patients hospitalized with Syncope

Pulmonary embolisms are blood clots located within the pulmonary artery. They are commonly formed by Deep Vein Thrombosis (DVT), which is a deep blood clot positioned in the vein of a leg. Eventually, it breaks off and flows through the blood to the heart near the pulmonary artery where it becomes a Pulmonary Embolism (PE). DVT is caused by specific events such as open surgery, obesity and cancer. Pulmonary Embolisms occur rapidly, and if the patient doesn't receive immediate medical attention, death can occur within minutes. The symptoms are rapid and often unnoticeable. Syncope is a short, quick loss of consciousness, that may include falling and fainting, as a result of a loss of blood flow to the brain. In the body there are three types of blood: A, B, O, and AB blood. It is confirmed that people with non-O blood have an increased chance of Venous Thromboembolic (VTE) and cardiovascular diseases, but not PE. Patients hospitalized for first period syncope have proven to a higher number of PE in their body resulting in 1 of every 6 people becoming diagnosed, but there is no record whether different blood types can have an effect on a person's probability of having a high amount of PE. In this experiment, the goal is to see whether different blood types will increase a patient's chance of becoming diagnosed with PE once hospitalized for syncope. This study can help find out whether different blood types are susceptible to accumulating PE in a person after receiving syncope. If different blood types will be tested, than non-O blood types will have the biggest chance of increasing a person's chance for PE after hospitalized with syncope.

Darien High School
Christine Leventhal, Teacher

Charlotte Juan**Project #197**

Research Proposal, Science, Environmental

The Effect of Nitrogen Dioxide on the Growth and Development of Tomato Plants

Nitrogen dioxide is one of the most prominent air pollutants and is mainly produced by high temperature combustion. The internal combustion engines in automobiles that burn fossil fuels are the main contributors to the nitrogen dioxide concentration in the air. The effect that nitrogen dioxide has on vegetation has been well documented, however, the specific effect of different concentrations of nitrogen dioxide on tomatoes has not yet been studied. The proposed study would fumigate tomato plants in nitrogen dioxide at 0.25, 0.5 and 1.0 ppm for approximately 2 hours to study the effects on the overall health of the plants. Some factors that would be documented to determine the health of the plant would be the number of leaves, the average area of the leaves, and the number of fruit. It is hypothesized that the increased levels of nitrogen dioxide would have a negative effect on the number of leaves, leaf area, and the number of fruit. Therefore the overall decrease in health of the tomato plants would have a negative effect on both the abundance and quality of the tomato fruit produced. If the hypothesis is proven true, then the adverse effect on the tomato plants would indicate that to increase the abundance of the yield of tomato fruit, tomato plants should be grown away from high traffic areas. Some possible future work would be to test tomato plants that have been grown in a high traffic area compared to tomato plants that have been grown in a low traffic area.

Darien High School
Guy Pratt, Teacher

Catherine Gorey**Project #198**

Completed Project, Science, Behavioral

Cognitive Strengths and Weaknesses of Adults with Reading Disabilities

Dyslexia and Reading Disabilities (RDs) are cognitive-based neurodevelopmental conditions that are rooted in biological and genetic neurological differences that are characterized by deficiency in the acquisition of language skills. RDs and Dyslexia affect 10-15% of the school-aged population. RDs have been linked to differences in cognitive abilities, brain functionality, and neural anatomy. Many studies that evaluate the core deficits of dyslexia using longitudinal studies of younger children; however, there are few studies that evaluate reading disabilities in older populations. WAIS scores of several populations affected by RDs were used to evaluate the effect of age and education on cognitive abilities in adults with reading disabilities, and examine the core cognitive weaknesses associated with reading disabilities. The results of this study suggest that working memory is the core deficit of reading disabilities. The data suggest that deficits in processing speed can be improved with education. The results indicate that education and age have a positive effect on cognitive function, with education being the most important factor in compensation for associated weaknesses. Overall this study presents important findings for the underlying cause of dyslexia, how RDs present themselves in adulthood, and provides important information for special educators and policy makers when developing education plans to target these deficits and diagnostic tools.

Darien High School
Guy Pratt, Teacher

Will Granath

Project #199

Completed Project, Science, Environmental

Developing a Robust Phylogeny of Xyridaceae and Closely Related Families

The study of Phylogeny depicts the evolutionary history of organisms and the relationships among individuals or groups. Phylogenetic trees can be used to assess biodiversity, evolution, ecology, and genomes. The family of Xyridaceae contains 5 genera and hundreds of species. They are flowering plants characterized by grass-like appearance, and can be used as bioindicators due to inhabiting coastal plains and wetlands. They sustain an important role to wildlife, providing pollen and seeds. The problem analyzed in this study examines whether the Xyridaceae family and other genetic families are more closely related to each other than to other species/families. This assesses the monophyletic nature of the Xyridaceae family. We hypothesized that the genera of Xyridaceae are monophyletic, and the family is monophyletic. This was assessed by employing as many data sets as possible over several disciplines. A seed atlas was created using a Scanning Electron Microscope and Orion Software to image the seeds of Xyridaceae across multiple genera. These were statistically analyzed and compared for their length, shape, apex shape, type of striae, and type of cross line. The other disciplines included molecular sequencing, cytology / anatomy, and morphometrics / macromorphology. While the implications of this research are mainly academic, it does give us access to a store of knowledge on gene-to-trait expression and its value. This is part of an ongoing study, however, the hypothesis is expected to be supported.

Darien High School
Christine Leventhal, Teacher

Hannah Knight

Project #200

Research Proposal, Science, Health and Medical

REM Sleep is Casual to Improved Short Term Memory Consolidation

It is commonly known sleep has an immense impact on memory. REM-dominated sleep specifically has been pinpointed as to having a positive correlation with recall of fear stimuli. REM sleep is the final phase of sleep cycle where most of our dreams occur. This is explained by our dreams reflecting the memory consolidation and information processing that occurs in earlier phases of sleep. This proposed research is trying to determine what phase of sleep will improve short term memory performance. Short term memory will improve when taking the Human Benchmark Memory Test after REM-dominated sleep. In this study, subjects underwent the Human Benchmark Memory Test before manipulating their sleep schedule with a split-night protocol with 80 healthy teenager participants in four groups. Test scores will be recorded before the split-night sleep and after their second recovery night of sleep. Short term memory did not improve after sleep dominated by SWS. Sleep dominated by REM sleep led to higher scores on the Human Benchmark Memory Test. We conclude that REM-dominated sleep leads to improved short term memory in teenage participants. This will impact neuroscientists looking into the split-night sleep protocol as therapy for sleep and/or memory disorders.

Darien High School
Guy Pratt, Teacher

James He

Project #201

Completed Project, Science, Behavioral

The Relationship Between Phonological Processing, Intelligence Quotient, and Reading Cognition: A Behavioral and Neurological Analysis

Reading serves as a fundamental aspect of educational success. It is a complex cognitive process, requiring many different brain regions to work in concordance for a successful experience. Reading disabled individuals are left at a disadvantage in life, so this study investigated the relationship between IQ; phonological awareness (PA), an individual's ability to manipulate phonemes; and reading cognition (RC), an individual's reading ability, to better understand and enhance reading development. It was hypothesized that IQ is positively correlated with a child's PA and RC, and that children with above average IQs exhibit less activity in the temporal lobe during the phonological decoding process while children with low IQs exhibit the opposite behavior. To investigate, approximately 200 randomly selected participants ages 3-7 from New Haven were tested three times over two years, using behavioral assessments and neuroimaging experiments with fMRI. There were positive correlations between IQ and PA as well as IQ and RC. These correlations strengthened as children underwent reading instruction, typically during first grade. Also, children with low IQs and PAs exhibit less bilateral temporal lobe activation when decoding pseudowords rather than real words, suggesting that children with low IQs and PAs do not have an automated phonological decoding process, a vital factor for a positive reading outcome. At the onset of reading instruction, IQ could potentially predict future reading outcome based on a child's future PA and RC. Potentially, children with low IQs are at risk for developing reading disabilities due to an inability to smoothly decode phonemes. To enhance the reading experience of a child with a low IQ, an intervention can be implemented to improve their phonological awareness.

Amity Regional High School
Deborah Day, Teacher

Emily Findlan

Project #202

Research Proposal, Science, Environmental

Groundwater Chemistry Changes before Major Earthquake and Possible Effect on Sea Urchins

In 2011, a 2.0 magnitude earthquake off the Pacific coast of Tohoku, Japan occurred. Still today researchers are investigating new ways to determine warning signs for when earthquakes are going to occur. In previous tests, many scientists have discovered that terrestrial animals have shown unusual behaviors before an earthquake strikes. However, few studies have been done on the relationship between earthquakes and marine species. The purpose of this study is to test the density of the kelp, *E. bicyclis* of a 1x1m quadrat before and after the earthquake, this will help understand the effect of the population of the sea urchins, because the density of the kelp increase as the population of the sea urchins decreases. The skeletal growth would also be measured in order to determine if "positive holes" have any effect on them. The skeletal arms should also decrease because as the pH of the ocean decreases the shorter the skeletal arms should be. The results of this study may indicate a previously unknown impact on marine life from underwater earthquakes. Then this study may indicate future research into the magnitude and distance from the fault line of earthquake impacts on marine life is warranted.

Darien High School
Guy Pratt, Teacher

Sana Pashankar

Project #203

Completed Project, Science, Health and Medical

HPV immunization rates among patients treated for childhood cancer

HPV is a sexually transmitted infection that can lead to cancer. In this study, HPV immunization rates among childhood cancer survivors will be compared among the healthy public. The independent variable is if participants had cancer and sex, race, hispanic, diagnosis, insurance, and primary care provider. The dependent variable is immunization rates. It is expected that if HPV vaccination is investigated, then survivors will have lower rates than the public. I reviewed patient information in the HEROES database, an official record of cancer survivors who attended an additional Yale Childhood Survivor clinic. Out of the eligible patients, I determined who actually received the vaccine. Frequencies were calculated and Chi squared or Fisher tests were run to determine the significance of the risk factors. Additionally, logistic regression tests were run for sex and the other risk factors to ensure their effects. Out of 139 eligible survivors, 106 received the vaccine. Sex was the only significant risk factor and female patients were 2.384 times more likely to be immunized than males. When comparing the survivor rates to the general population by sex, 81.7% of female survivors and 65.2% of male survivors were immunized as compared to 70.9% of girls and 65.3% of boys in Connecticut. Ultimately, the survivor cohort had a significantly higher rate of HPV vaccination than the general population ($p > 0.0001$), which does not support the initial hypothesis. Additionally, sex was shown to be significant factor of immunization in the survivor cohort. Despite the high rates of immunization for survivors, still more than 20% of survivors were not immunized, which remains a major issue for the survivor population.

Amity Regional High School
Deborah Day, Teacher

Aman Thombre

Project #204

Research Proposal, Science, Physical Science

Expanding the Materials Genome of Dielectric Materials Through Polyureas

A dielectric material is an insulating material that can be polarized. Dielectrics make up capacitors, which are used in renewable energy and pulsed power applications. The overall objective of this project is to find whether calculated and experimental electrical properties of dielectric materials match. My more specific objective is to see if a large dipole moment and having high aromaticity will yield desired properties, such as a high dielectric constant and thermal stability. To test this, different polyureas will be synthesized and analyzed to find their properties. In order to make the materials, polyureas will be synthesized and then characterized using condensation polymerization techniques. Then, using spin coating and doctor blade techniques, films will be casted. These films will then be analyzed through classical polymer characterization techniques as well as electrical measurements. Condensation polymerisation techniques include: TGA (sees whether condensation polymerization is complete), DSC (glass transition, degradation, melting and crystallisation temperatures), GPC (molecular weight) and IR spectroscopy (types of bonds present). Electrical measurements include: TDDS, breakdown measurements and UV-Vis (bandgap). TDDS and breakdown measurements will aid in determining the energy density of the material. Using this data, the experimental and calculated properties of the dielectric materials can be compared. Using the gathered data, this project aims to improve the current computational model for calculating properties of dielectrics. This project also aims to find out whether high dipole moment and aromaticity will yield desirable properties of dielectrics. With this information, it will be possible to identify monomers that can yield dielectric materials with desirable properties. This will allow us to potentially find novel dielectrics.

Amity Regional High School
Deborah Day, Teacher

Alicia Chen

Project #205

Completed Project, Science, Health and Medical

Determining Genetic Mutations in Gitelman syndrome

Gitelman syndrome (GS) is an autosomal recessive genetic disorder that impairs the kidney's ability to reabsorb salt and causes imbalances in electrolytes. GS is caused by a mutation in the SLC12A3 gene, and symptoms vary widely. The purpose of this study is to determine genetic mutations in the SLC12A3 gene that cause GS for diagnostic purposes and to see if the type or location of mutations affects severity of symptoms. Human DNA was isolated from blood samples and a PCR was used to amplify the SLC12A3 exons for Sanger sequencing, which provided the codes of the exons. This was done by mentor Dr. Weizhen Ji. The codes of these exons were compared to the DNA of healthy controls using the program Sequencher. This was done by me. I did not handle the blood or DNA. 4 missense mutations were found, with 3 different mutations in total: mutations R209G, A264G, and G461D, with the mutation A264G having been found twice in two different patients. This confirms the hypothesis that there are mutations in the SLC12A3 gene which lead to GS. GS is mostly diagnosed through phenotypic symptoms, though symptoms can be similar to other diseases. Phenotypes of GS are similar to those of diuretic abuse and bulimia as well as extremely similar to Bartter syndrome. The similarity of GS symptoms with these diseases suggest the need for genetic testing to accurately diagnose GS in patients. Identifying these mutations which cause GS will aid in diagnosing GS through genetic testing.

Amity Regional High School
Deborah Day, Teacher

Leah Mongillo

Project #206

Completed Project, Science, Behavioral

A Study of Attitude Towards High School Classes

Math anxiety is defined by a strong tendency to avoid math. People with math anxiety often panic when asked to perform simple, timed, arithmetic problems (Ashcraft, 2002). This study will look at the relationship between a student's math anxiety and level of math class. The independent variable is the level of math a student is taking. The dependent variable is the level of math anxiety a student has. This will be a mixed methods study. The participants will be students from different levels of Algebra II. The quantitative data will come from a modification of the Abbreviated Math Anxiety Scale or AMAS (Hopko, 2003). The qualitative data will come from three open-ended questions. The hypothesis is students in lower level classes will have higher levels of math anxiety. The quantitative data shows that students in lower level classes have higher levels of math anxiety but not enough to be statistically significant. The qualitative data shows supports the hypothesis and shows that teachers have a very large impact on how students perceive subjects. Based on the findings of this study, teachers will be able to better understand the students taking their classes. If data continues to show that students in lower level classes have higher levels of math anxiety, those who teach that level will be able to adopt teaching techniques that help math anxious students do better in that class and see how math is useful in their careers.

Amity Regional High School
Deborah Day, Teacher

Quinnlan Burke Project #207

Completed Project, Engineering, Health and Medical

Designing a Protective Cap To Reduce Impact Force and Head Trauma

Football is a historic game in the United States that has existed for over a century. Recently, research has uncovered unforeseen health risks associated with Football. Specifically, that of concussions. Concussions have been linked to degenerative brain disorders such as CTE (Chronic Traumatic Encephalopathy) and Alzheimer's. Innovations in safety are needed to help preserve this American pastime. A padded skullcap worn underneath the helmet would be a safe, comfortable, and inexpensive way to significantly improve protection from head trauma. It is hypothesized that a padded skullcap worn in conjunction with a football helmet will significantly improve protection from traumatic brain injury. The skullcap itself will consist of memory foam sections to offer protective qualities. The idea behind this skullcap is that it will offer superior protection to similar products, while also remaining relatively inexpensive and comfortable. Testing of the skullcap will take place at the CT Science Center. Data will be collected using the Crash Test Machine, and measured in g force. The data will then be analyzed statistically using a paired t-test and a one way ANOVA test. I designed, helped build, and tested the prototypes. The data from this project shows that these skullcaps significantly improve head protection. The ultimate goal is to patent the design, produce, and sell these skullcaps. These caps have the potential to keep athletes of all skill levels and age groups safe, and preserve the sport of football.

Amity Regional High School
Deborah Day, Teacher

Christina Lee Project #208

Completed Project, Science, Behavioral

Youth and parents working towards a shared perception of reality: The impact of psychopathological categories

Adolescence is an important developmental stage that epitomises the physical and psychological changes from childhood to adulthood. During this developmental period, many children are inclined to develop their own independent mindset. In this study, the focus will be on adolescents that have a psychiatric diagnosis. The main purpose is to determine how the level of agreement between the youth and parent severity scores vary as a function of broad diagnostic categories. The Yale Child Study Center Intensive In-Home Child & Adolescent Psychiatric Service (IICAPS) is an intensive treatment that assists families with children who have psychiatric disorders. The parents and adolescents are asked to rate the severity of the youth's presenting problems by using the OHIO scale before and after the IICAPS service is provided. There will be a sample of approximately 1000 completely de-identified IICAPS cases that will be evaluated. Data is still being collected. The data will be interpreted by using independent sample t-tests to compare the average scores of each group. Subjective experience is a crucial aspect in order to evaluate clinical severity. Due to the difference perception that parents and children hold, this will have a significant influence on the evaluation of clinical severity and will provide a target and measure of optimal psychiatric treatment.

Amity Regional High School
Deborah Day, Teacher

Anisha Jain**Project #209**

Completed Project, Science, Health and Medical

Pathological And Histological Difference In Hepatocellular Carcinoma Phenotypes Between Cirrhotic And Noncirrhotic Patients

Hepatocellular carcinoma (HCC) is the most common primary liver cancer and the second leading cause of cancer mortality in the world. While the incidence of viral hepatitis C and B has been decreasing worldwide in recent years, and the proportion of HCCs arising in non-cirrhotic patients seems to be increasing. In this study, the correlation of various HCC phenotypes that arise in cirrhotic versus non-cirrhotic patients will be evaluated. The independent variable is whether the patient with HCC has cirrhosis or not. The dependent variable is the phenotype (or distribution of phenotypes) of HCC in each group. The control group is the patients who developed HCC after they had cirrhosis. For this study, patients with HCC diagnosed at Yale New Haven Hospital and at the Veterans Hospital in West Haven will be retrospectively identified from institutional databases. The histologic slides will be retrieved from the archives and reviewed under a light microscope in the Department of Pathology at Yale New Haven Hospital and the tumors will be phenotyped using already published criteria. The correlation of HCC phenotype with the presence of cirrhosis will be analyzed. Statistical analysis using a t-test. Through published criteria, it is speculated that steato-hepatic type will arise more frequently with those who have non-cirrhotic HCC, while other types will be more common with those who have cirrhotic HCC. Implications of this study is that hepatologists will have more clear etiological factors to look for as predictors of HCC.

Amity Regional High School
Debroah Day, Teacher

Alexandra Bonat**Project #210**

Completed Project, Science, Health and Medical

Analyzing Determinants for Obesity in Adolescent American Indians

The increasing rates of obesity in youth has become a large problem in American Indian populations because of the risk of complications such as diabetes, cardiovascular disease, cancer, and arthritis. The objective of this project is to describe weight and obesity categories in American Indian youth 15-25 years of age during two examinations, describe weight changes, and explore whether measures of physical activity and diet intake correlate with weight gain. Data will be taken from the fourth and fifth examinations of the Strong Heart study. During the fourth exam, the Strong Heart Study evaluated 120 families, a total of 3600 individuals 15 years of age and older in 2001-2003, and during the fifth exam they re-evaluated these individuals in 2007-2009. Physical activity was assessed using a questionnaire and a pedometer log, and diet was assessed using a food frequency questionnaire. ANOVA found no significant difference in nutrition and physical activity variables between quartiles of weight change, though multi-variable models will determine whether that is due to confounding variables or outliers. After these initial analyses, multiple regression analysis will be used to assess predictors of weight change. Univariate models will be run for steps per day and the nutrition variables, and then multivariable models will assess each one adjusted for the others. It is hypothesized that increasing numbers of steps per day and number of vegetables and fruits eaten per day will be associated with less weight gain, and that increased calorie and sugar intake will be associated with more weight gain. This study will help ascertain lifestyle determinants of obesity, which can lead to the initiation of healthy lifestyle habits at a young age to prevent development of obesity and its future complications.

Amity Regional High School
Deborah Day, Teacher

Summer Schaaf
Neha Sudhir

Project #211

Completed Project, Science, Environmental

**The Impact of Ocean Acidification
On Phytoplankton**

Since the Industrial Revolution, the pH of surface ocean waters has decreased, a process known as ocean acidification. Seawater absorbs CO₂ released into the atmosphere, causing carbonate ion concentration, which may be killing many marine organisms. In this experiment, the impacts ocean acidification on phytoplankton will be investigated. The independent variable is the CO₂ exposure. The dependent variable is oxygen production. It is hypothesized that if more CO₂ is introduced to Long Island Sound, more oxygen will be produced. The materials needed include water from LIS, spectrophotometer, and pH meter. Water will be divided into nine containers of equal size with three groups with different treatments. Zooplankton will be removed to avoid interference with the growth of phytoplankton. The results show that, in general, exposure to carbon dioxide leads to higher levels of algal biomass and the differences are statistically significant. With no exposure to carbon dioxide (T2), biomass levels were lower relative to both moderate (T1) and high (Control) exposure treatments (with p < 0.05). The confirmation of the hypothesis that if more CO₂ is introduced to the Long Island Sound water, more oxygen will be produced, indicating an increase in phytoplankton populations, so this information can be used worldwide in investigating the consequences of ocean acidification and in finding a way to counteract its effects.

Amity Regional High School
Deborah Day, Teacher

Lindsey Kupcho

Project #212

Completed Project, Science, Behavioral

**The Impact of Resources on the Quality of Life for
MWS (Mowat Wilson Syndrome) Individuals**

The Impact of Resources on the Quality of Life for Mowat Wilson Syndrome Individuals will be tested. Quality of life will be measured by the percentage and number of possibilities in these individual's lives. Possibilities result from opportunities and resources each person has in his life. My cousin and family suffers with this syndrome everyday and deserves the best quality of life possible, along with other families enduring similar situations. Medical, communal, family and state resources will be surveyed. From the online survey, baseline information will be retrieved to determine which area of MWS life needs the most attention. Discussing and analyzing these results with a credentialed speech pathologist and Yale geneticist will contribute expertise on the significance and implications of the data in the real world. Face to face surveying occurred as well. Mobility, communication and language development would be most effective to research. The state provides only basic disability programs. Mobility braces have helped for about 86% of individuals. Families connected through Facebook support groups or the MWS foundation to help them cope. Public schools and religious centers have accommodated to MWS individuals. Music and television are the most popular means of entertainment to keep the individuals calm. This investigation has means to help families impacted by Mowat Wilson to explicitly see what areas of life need to be most improved upon to make life for people impacted by MWS more enjoyable. It a first step to helping the MWS community. From there, that specific issue can be treated.

Amity Regional High School
Deborah Day, Teacher

Madeleine Black

Project #214

Research Proposal, Science, Environmental

The Relationship between Iron Levels and Toxic Algae in the Long Island Sound

Prior studies have shown a direct correlation between iron and toxic algae, such as *Pseudo Nitzschia*, in large bodies of water. Testing, however, has not been conducted in the Long Island Sound (LIS). The purpose of this experiment is to determine whether the presence of toxic algae correlates to high levels of iron in the Long Island Sound. Areas with high iron levels are expected to have high levels of toxic algae. First the water will be collected from different areas of the LIS and tested for its iron level. Next the water will undergo domoic acid testing and DNA barcoding. Domoic acid is produced by *Pseudo Nitzschia* and therefore if its presence is found in the Sound, *Pseudo Nitzschia* will also likely be present. DNA barcoding will be used to confirm the presence of other possible toxic algae. Control water samples will also be tested. It is expected that areas with higher boat traffic, specifically the Stamford Yacht Club and the West Beach boat launch in Stamford, will have higher iron levels and therefore a larger presence of toxic algae. Out of the areas where water has been collected thus far, two have had low boat traffic and one has had heavy boat traffic. The areas with low boat traffic will be compared to the areas with high boat traffic. At this point, preliminary results show that the areas with a higher level of boat traffic have a higher level of iron. Domoic acid levels and DNA barcoding results are in progress and more samples will be collected and tested. This experiment is significant because it could add to the knowledge that links the presence of iron and toxic algae, and will also provide important information on the safety of the Long Island Sound.

Convent of the Sacred Heart
Mary Musolino, Teacher

Mounisha Anumolu

Project #215

Completed Project, Science, Environmental

Implementing Nutrient Uptaking Bacteria to Remove Excess Chemicals from Eutrophic Water in Simulated Pond Ecosystems

Eutrophication, over-enrichment of nutrients in marine ecosystem, detrimentally affects biogeochemical cycles. Caused by human and point-source pollution, eutrophication has resulted in an overabundance of nitrogen in small ponds worldwide, creating large harmful algal blooms. Recently, an ecological engineering company, LivingMachines, has used microorganisms to remove nutrients from wastewater. This study will explore whether the implementation of specified denitrifying bacteria into eutrophic water will remove excess nutrients from water. Four tanks (NC/N1/N2/N3) will have water overenriched with nitrogen, using nitrogen fertilizer. Nitrogen tank (Nitrogen Control) will have agar and algae, but no bacteria. N1 tank will have agar, type of nutrient-eating bacteria, enriched water, and algae. N2 and N3 will be similar, except with different bacteria (*Pseudomonas fluorescens*/*Escherichia Coli*/*Bacillus Subtilius*), Four more tanks will be set up exactly the same way for two trials. Because added algae have nutrients available to them, algal blooms will form in each. Using a turbidity meter, size of blooms can be quantified. Measure from control will be compared to experimental trials. If the bloom in the bacteria trial is smaller, it can be determined that less nutrients were available for bloom to grow and which bacteria was effective in limiting nutrients. Preliminary data is indicating that *P. fluorescens* is resulting in the smallest algal bloom. Whichever bacteria resulted in the smallest algal bloom will be considered the best at uptaking nutrients and fighting eutrophication. By determining this, the implementation of this bacteria into eutrophic ecosystems can further be explored to help fight eutrophication. Eutrophication kills many organisms and ruins ecosystems worldwide. Identifying the best bacteria and moving forward with implementation will be a step towards reducing eutrophication and helping ecosystems.

Amity Regional High School
Deborah Day, Teacher

Emily Criscuolo

Project #216

Completed Project, Science, Health and Medical

Investigating Murine Humoral Responses to Tick-borne Pathogens to Develop a Confirmatory Diagnostic Tool

An infection with the relapsing fever spirochete, *Borrelia miyamotoi*, could easily be confused with the Lyme Disease vector, *Borrelia burgdorferi*. Both of the spirochetes are extremely similar in that they express many of the same proteins; they also cause almost identical symptoms. There is a need for improved methods of diagnosis of *B. miyamotoi* which can only be done by expanding our knowledge of the host's interaction with the pathogen. To investigate this, sera from the laboratory mice experimentally infected with *B. miyamotoi* was evaluated for cross reactivity of antibodies to *B. burgdorferi* and vice versa. *B. miyamotoi* infected sera from various points along the course of the infection was evaluated against a *B. miyamotoi* lysate. First, an SDS-PAGE assay separates the proteins contained in each lysate then an Immunoblot assay indicates the presence of bound antibodies to these proteins. There was ample reactivity between the *B. burgdorferi* infected sera and the *B. miyamotoi* lysate. There was a limited amount of reactivity the opposite way. The immunoblot using *B. miyamotoi*-infected mouse sera and *B. miyamotoi* lysate revealed the presence of two protein bands in the lysate with differential reactivity to the mouse antisera, suggesting that the cultured *B. miyamotoi* contained at least two distinct populations (serotypes) of *B. miyamotoi*. Because of the unexpected amount of reactivity between the *B. burgdorferi* infected sera and *B. miyamotoi* lysate, there is a need to identify specific proteins that can differentiate between the two infections. The discovery of the two serotypes is extremely helpful because we have identified two proteins that are expressed by *B. miyamotoi* that allows it to escape complement killing by the mouse's immune system and differentiate between the infections.

Amity Regional High School
Deborah Day, Teacher

Khaled Jarad

Project #217

Completed Project, Science, Behavioral

What Effect Does Using a Laptop, iPhone, or Desktop Have on the Ability for a Person to Retain Information from a Presentation

Technology is changing the way people do things in their everyday lives. But because there are so many different platforms and devices to use people have no way of knowing which is the most effective and efficient in transferring information. Universities and schools could be overspending and wasting time on technology that is not compatible for their students. Specifically their older students seeking higher education. Not much research or implementation of technology has been done in adult learning environments. This project is researching which technology is most compatible with older students. Moreover, the purpose of this research is to discover which device is the easiest to retain information from. To test the efficiency of the devices participants will be asked to view a visual presentation. After the participants view the presentation on their device, they will take a survey. This survey will assess recall not understanding. Based on the grade each participant gets on the survey I will be able to tell which device yields the best scores and is ultimately more efficient. It is hypothesized that if the participants use a computer they will be able to retain more information from the presentation. To clarify, the independent variable is the Platform/Device used to project the presentation and the dependent variable is the amount of information retained (Measured by test score).

Amity Regional High School
Deborah Day, Teacher

Haya Jarad

Project #218

Completed Project, Engineering, Behavioral

Identifying Quasi Periodic Patterns in fMRI versus CBF Data

Brain waves contain the code to understanding how the brain functions. They are detectable using Functional MRI, which depicts trends in neuronal activity over time. Brain waves often behave in a periodic fashion, however recently scientists have observed that they can occur semi or quasi periodically. This study is refining an algorithm, designed in a previous year's study, that will identify these "quasi periodic patterns"(QPPs). In order to determine "consistency" various statistical analysis tools will have to be employed. The specific tests have not yet been selected as it is still unclear how the data will present itself. I will be inputting two sets of data from two scans taken at the same time to test the algorithm. It is anticipated that both data sets will turn out similiar results as one data set measures blood flow and the other measures concentration of a molecule found in blood. the algorithm created as a part of last year's project, was built around a preexisting algorithm. It was altered to accommodate the array size of a human brain. After this adjustment was made it was found that by providing the algorithm carrying parameters to run calculations in, the results were different. The algorithm did not identify the same patten every time because the template pattern provided was changing. this study will work to identify the parameters which provide the most consistent identified pattern when evaluating brain scan data. once QPPs are identified, scientists can begin to truly test and understand them. It is still early to determine exactly what they are as studying them has been so difficult, however this study aims to fix that problem.

Amity Regional High School
Deborah Day, Teacher

Yuqi Zhou

Project #219

Completed Project, Science, Behavioral

Exploring Young Children's Social and Emotional Skills in Early Childhood Classrooms

Emotional Intelligence is the ability to monitor one's own and other's emotions, to discriminate among them, and to use this information to guide one's thinking and actions. Culture and ethnicity play a role in emotional intelligence, but little is known about how and in what ways. Although universality presents at the core of how emotions are expressed, there remain differences in how emotions are thought about and expressed between cultures. In this study, we explored culture's influence on children's emotional intelligence in the classroom environment. Culture is defined as race and the spoken language. Two approaches were taken, approach 1 is the cultural match between a child and the teacher and approach 2 is the cultural diversity in the class. Both approaches' effect on children's social and emotional skills were explored. A dataset from past years was analyzed. Information regarding children's social and emotional skills, key demographic information, language spoken at school, and language spoken at home were especially looked into. Linear regressions were performed to see whether and how variance in children's social and emotional functioning depends on the two approaches. Emotional Intelligence is essential for personal, social, academic, and professional success. For example, children who are more emotionally intelligent are more likely to have better social competence and school adjustment, thus it is important to ensure a good classroom environment at early stages of childhood. The analysis in this study concerning culture would help to better understand a better classroom environment for children's emotional intelligence.

Amity Regional High School
Deborah Day, Teacher

Sarah Saxe

Project #220

Completed Project, Science, Behavioral

Effects of Feces Deposition in Natural Refuges on Common Bedbug, *Cimex lectularius*

L. Aggregation

Nearly 20% of Americans have had or know someone who has had a bedbug infestation. They depend on exterminators, but pests often return. Extermination is expensive and uses harsh chemicals such as pyrethroids, which bedbugs with thick cuticles have grown resistant to. As an alternative to extermination, could a bedbug's own feces or shed exoskeletons act as an attractive beacon to herd bugs to a trap to then be removed? To test, 20 adult bedbugs from the Harlan-line were placed into a choice chamber. Left equidistant from two ends they were given 24 hours to roam. Pallets that were blank or coated with bedbug fecal matter were placed on opposite ends of the chamber. The independent variable is the presence or absence of fecal matter on the pallet. The control is the pallet without any added material. The dependent variable is the pallet the bedbug chooses to reside on. Overall, 117 trials were completed. Out of the trials, 85, or 72.65%, of bugs aggregated at the refuge with fecal matter and 32, or 27.35%, of bugs aggregated at the blank. A paired t-test, with a two-tailed distribution probability statistical analysis was performed with a p-value of 0.0196016, thus demonstrating the statistical significance of the research. If bedbugs are attracted to this natural beacon, then the use of harmful chemicals and pesticides to exterminate the bugs could be eliminated. This would benefit the environment, prevent the developing pyrethroid resistance, save people time and money, and also alleviate legal disputes between landlords and tenants over the cost of extermination. This could be a cheap, natural alternative to harmful extermination treatments.

Amity Regional High School
Deborah Day, Teacher

Jimmy Bi

Project #221

Completed Project, Engineering, Physical Science

Improving the Outbrain Click Prediction Algorithm

Outbrain is an online advertising company specialized in presenting sponsored website links. The organization utilizes behavioral targeting, a technique which takes into account the web browsing history of the individual. Outbrain is hosting a competition on kaggle, an online platform dedicated to predictive modeling and analytic competitions that statisticians and data miners compete in. The specific purpose of the project was to improve upon Outbrain's algorithm to predict which recommended content each user will click and submit a script to kaggle by the deadline January 18th. Specifically, the objective of the intended script was to predict whether or not a user would click on the advertisement. The script would be able to do so with the use of a training data set containing variables used in behavioral targeting. It would be necessary to create an array of decision trees that classify the data into subsets by individually pairing the explanatory variables with the response variable indicating whether or not the advertisement was clicked. The Random Forest Algorithm, an algorithm essential to machine learning and classification, constructs several of these randomly. The prediction is evaluated by the result of the majority of trees in the forest. Prediction rate using a separate testing data set would be used to evaluate the proficiency of the script. Coding was done at home through a device directly on the kaggle website, using the Python language and the various csv files containing the data sets. Due to an unidentifiable error, the script could not be completed. Additional circumstances with the online script editor extenuated the issues. However, the procedures involving the creation of Random Forests were still thoroughly explored.

Amity Regional High School
Deborah Day, Teacher

Alexander Friedman

Project #222

Completed Project, Science, Health and Medical

The Effect of Peptidoglycan and its Components on Cytokine Production

This study investigated peptidoglycan and its effect on macrophages. An article by the Institute of Molecular and Cellular Biology in Cedex, France states that immune response against gram-negative bacteria is mediated by a peptidoglycan recognition protein. This experiment will document the effect of peptidoglycan, intact and digested, on TNF-alpha response. The hypothesis is that different peptidoglycans will result in different cytokine responses, and digested peptidoglycans will yield a lesser response. Serial dilutions of peptidoglycan were performed to find the ideal concentration. Then different peptidoglycans from *B. subtilis*, *M. luteus*, and *S. griseus* were incubated with mouse peritoneal macrophages to determine TNF-alpha release. A lysozyme digestion of peptidoglycan, and the components of peptidoglycan were tested as well. The three different peptidoglycans produced different TNF alpha responses. A lysozyme digestion of peptidoglycan produced a lesser response. N acetylmuramic acid produced a lesser response. The combination of N acetylmuramic acid and N acetylglucosamine produced the smallest release of TNF-alpha. Peptidoglycans from different bacteria produce different immune responses. This may indicate that the peptide chains on peptidoglycan are different in different bacteria. Digested peptidoglycan produces less of a response as does the component N-acetylmuramic acid. This may indicate that once the cell wall is digested, the immune response is no longer necessary since the bacteria has been killed, and that intact peptidoglycan is needed for the most vigorous response.

Amity Regional High School
Deborah Day, Teacher

Lillian Zhang

Project #223

Completed Project, Science, Health and Medical

Using Wnt1 and Sox10 as Markers for Craniofacial Osteosarcoma Tumor Cells for Retainment of Neural Crest Stem Cells

Osteosarcoma (OS) is the most common form of primary bone cancer and the third most common malignancy for adolescents. Primary craniofacial OS tumors form in areas of the skull that are derived from the embryonic rests of the neural crest due to the malignant transformation of neural crest stem cells. Because bone and jaw parts come from the neural crest, it is suggested that there are still some stem cells that remain. The purpose of the study is to compare expression patterns in the craniofacial OS tumors and stem cell patterns to develop a better understanding of how OS tumors arise from neural crest stem cells (NCSCs). The NCSCs will be labeled immunohistochemically using an antibody against Wnt1 and Sox10. The cells will be captured using laser capture microdissection to isolate populations. Then, the patterns of expression of the cells can be analyzed to similarities. The control cells (the long bone osteosarcoma) and cells with tumor in the adult and young mouse jaws of 8.5, 10.5, and 16.5 day embryos will be compared to neural crest stem cells. After comparison among groups using green fluorescent protein tags for Wnt1 and Sox10, Graph-Pad Prism is used for statistical analysis. The results from the study will be useful in understanding whether primary craniofacial OS tumor cells with similar properties of cancer stem cells still have the persistent neural crest stem cell properties. If results demonstrate that OS tumors are derived from the neural crest origin, future implications can include the ability to make therapeutic strategies to target OS and produce markers for tumor margins to refine surgical intervention.

Amity Regional High School
Deborah Day, Teacher

Sebin Park

Project #224

Completed Project, Science, Environmental

Examining variations in immunity related genes of bananas of different geographic regions through genotyping

Banana diseases have been a continuous problem for many years. Bananas are easily susceptible to diseases because most commercial bananas are clones of each other. This study will look into the variation of genes related to the immunity of the bananas from different geographic regions. It is hypothesized that there will not be significant variations in the immunity related genes because most bananas are clones of each other. The first step of this project will be to identify specific genes related to the immunity of bananas from the chitinase family and find markers. Bananas from different regions will be collected from available stores, and DNA samples will be extracted from each. Next, the samples will be ran through a genotyping test, Sanger's sequencing, to see the variations of the specific genes identified before. The sequencer software was used. The sequence data collected was uploaded to a software program that aligns the sequences obtained with the known sequences. The data is presented with allele frequency table or figure. If the data supports the hypothesis, the range of the regions can be taken into consideration to suggest the lack of genetic variation in such range of area.

Amity Regional High School
Deborah Day, Teacher

Weixin Du

Project #225

Completed Project, Science, Behavioral

Effect of Literature POV on Lasting Empathy

Studies show that literature has great influence, even when fictional, and can even increase in effect over time. Strong narrative immersion makes readers more empathetic to the text. However, while some research has been done on what kind of point of view creates the strongest immersion, but none looks at how POV impacts empathy over time. Research will be done comparing first and third person narratives and lasting empathy. Participants first take a short questionnaire measuring the subjects' empathy. After some filler tasks, participants will read a short story to read written in first or third person. Participants will re-take the empathy questionnaire, and take it again a week later. There will also be questionnaires assessing transportation into the narrative and understanding of the narrative. While data currently has not been collected, scores from before, right after, and a week after taking the questionnaire will be compared and analyzed for significant differences. The scores between the third and first person groups will also be compared. Literature has already been looked at for persuasive purposes in spreading messages, such as global warming and dangers of smoking. Data from this research could aid in crafting narratives for such purposes. This information could also be utilized in creating narratives for advertising, political, commercial, or otherwise.

Amity Regional High School
Deborah Day, Teacher

Henry Molot

Project #226

Completed Project, Science, Health and Medical

Data Analysis: Is It More Effective to Get Surgery or Use Physical Therapy Following a Ruptured Heel Cord?

The purpose of this research project is to determine which method is more effective following an Achilles rupture: operative or nonoperative treatment. Despite being the strongest and largest tendon in the body, an Achilles rupture is a common injury to professional and everyday athletes alike. Being faced with the difficult decision of a possibly dangerous surgery or months of PT is a difficult and vital choice for athletes. The means of data collection will come from various online databases such as PubMed, Medline and the American Journal of Sports Medicine. In this project, the student will be searching for, collecting and analyzing and compiling only the most important and relevant data on participants who have ruptured their Achilles tendon. After an in depth literature review and data collection is conducted, statistical analysis tests will be applied to collected data. After collecting data, it has been found that the data shows statistical significance favoring the hypothesis. The re rupture data shows that operative treatment will reduce the chance of re ruptures, while the complications data indicates that non operative treatment will be most effective when trying to reduce post treatment complications. The operative group also showed a lower prevalence of calf atrophy in comparison to the non-operative groups. Surgery versus non surgery is an important choice for all athletes who rupture their achilles. There are many complications surrounding surgical treatment, and many factors which will determine how the athlete responds to treatment. This data indicates that professional athletes should use operative treatment for a quicker return and a small chance of re rupture, while casual athletes should choose non operative to reduce the chance of post treatment injuries.

Amity Regional High School
Deborah Day, Teacher

Baasim Zafar

Project #227

Research Proposal, Science, Physical Science

The Effects of Different Sources of Light on Amount of Joules Generated by a Solar Panel

There have been more solar powered robots being used recently, however one thing that is not clear is that which source of light would be the most efficient and if it is better than charging it from an outlet. The hypothesis is if the high performance halogen is the source of light, then the most energy will be generated. The independent variable is the source of light. The dependent variable is the amount of Joules generated. Two tests will be conducted to see which source of light is the most efficient. The light sources will be incandescent bulb (PAR38), Incandescent reflector (R63), high performance halogen, normal incandescent bulb, and infrared. In the first test a solar panel would be put underneath the artificial light source for a total of 45 minutes and at a 30 degree angle. The power being generated will go to a Lego NXT energy meter that displays amount of Joules generated. The amount stored will be recorded every 15 minutes. A pretrial may be conducted to see the time for generating Joules. For the second test the robot will be going across 5 meters of carpet under a light source. The light source will be held up by a claw that is on the robot. After it has ran across 5 meters the amount of Joules will be recorded. Then it will be possible to see how many Joules were lost after the 5 meters. The amount of Joules remaining will be recorded and that amount will be subtracted from the amount in the first test.

Amity Regional High School
Catherine Piscitelli, Teacher

Anthony Tom

Project #228

Research Proposal, Science, Health and Medical

The Effect of Being Underwater on the Accuracy of Optical Heart Rate Sensors during Resting Conditions

In the past few years, optical heart rate sensors have become more common among fitness devices and wearables. Using light allows heart rate to be viewed much easier than with previous methods like a chest strap. This makes pros such as ease of access and 24/7 tracking, but cons such as being less accurate. Additionally, these sensors are not accurate underwater and cannot be used in activities such as swimming. This experiment seeks to see the changes and differences between two identical sensors which are accurate in steady state and daily activity, Garmin Forerunner 235s, during resting conditions. One sensor would be placed underwater while the other would be worn as normal on the other wrist. Heart rate would be collected every second for five minutes and the two tracks would be compared. The tracks will then be compared. Predicted data is that the heart rate track from the watch placed under water will have a more variable, and inaccurate heart rate track. Resting conditions were chosen due to their relative simplicity as compared to an extended bout of exercise. This experiment hopes to find any trend in inaccuracies under simplistic conditions and then extend to more complex and involved scenarios like the aforementioned swimming.

Amity Regional High School
Catherine Piscitelli, Teacher

Jody Liu

Project #229

Research Proposal, Science, Behavioral

The Effect of working in a Group have on Time Perception

Time perception is someone's own perception of the duration of the indefinite and unfolding events. The fundamental aspects of one's experience of time is duration, order, past and present, and change (light and sound). This experiment is trying to test whether or not perception of time is faster than in a group rather than alone. It is predicted that if one works in a group, then their perception of time!!! will be faster than real time and perceived working time alone. The independent variable is working alone or in a group. The dependent variable is the participant's' perception of time (not actual time) taken to complete a puzzle. Each participant will complete a forty-eight piece jigsaw puzzle, and report how long they believed they took. Each group will be split into three people. Groups A and C will work alone!!!! first, then work in a group. Groups B and D will work in a group first, then alone. After the difference between the perceived time and actual time will be calculated. Then the difference between perceived and actual time in a group or alone will be compared. This research can be used in the future for teachers to know whether it is more entertaining for students learn alone or in a group, and they can create projects and activities based on this.

Amity Regional High School
Catherine Piscitelli, Teacher

Website Domain Suffixes and Their Reliability

Each year, millions of computers are infected by malware through use of malicious websites on the internet. Research shows that about 30% of the United States' computers are infected by some kind of malicious software. Does one's age affect their judgement on the safety of certain websites based on their domain's suffix? Most likely, the older someone is, then they will originally choose a potentially less safer domain name than someone who is younger. The suffix that someone originally chooses will be the independent variables, and their perception of the website after viewing it will be the dependent variable. One important constant is the participant's access to a computer. They must need some form of a device that can connect to the internet, so they're familiar with a domain and its purpose. Another variable that must be controlled is the participant's job/living. They'll give them an advantage over others who don't have this type of job and could distort the results of the survey. There'll be 10 real life domains. There'll be 2 groups of 5 domains. Each group containing the same 5 prefixes while the suffixes are one of 5. The participants will say which websites they feel are trustworthy without visiting them. After they visit them, they will state their opinion on the website's credibility again. Hopefully, their perception of the website after visiting it has changed. A frequency chart will be made to map out each age group and their choices of trustworthy suffixes.

Amity Regional High School
Catherine Piscitelli, Teacher

Type of Relationship between Perceived and Actual amount of Time Spent on Instagram/Snapchat

In the past nine years up until 2014, on average, teen social media usage has increased in amount from 9 to 89 percent. Studies show that social media has a direct effect on one's self-esteem, sleep levels, anxiety, and other mental health issues. "Liking" pictures through social media gives the brain a bonus through the reward circuitry, resulting in going on more to feel happier and becoming addicted. The average person, age 18-29 spends about 50 minutes on Snapchat and Instagram daily. The question to be investigated is the relationship between the perception and actual amount of time spent on Snapchat and Instagram. If one is asked how much time they had spent on social media, then the perceived amount of time will be less than the actual time spent. To begin, a survey will be created for all participants that will include; initial perceived amount of time spent, actual amount of time spent, if the results were surprising, the percentage of change between the actual and perceived amount of time, and when the user felt the most amount of time was spent (downtime or homework). The actual amount of time will be determined by looking under time usage on the participants' iPhone with iOS 9 or higher. The survey will ask for the participants' perception of usage over different amounts of time, 24 hours, 3 days, and 7 days. Data collected will be analysed for the varying amounts of change and how social media affects perception of the amount of time wasted.

Amity Regional High School
Catherine Piscitelli, Teacher

Hannah D'Arche**Project #232**

Research Proposal, Science, Behavioral

The effect of watching a video of a dog on stress, measured through heart rate.

An area of current research is the positive effect of animal presence on humans. A few examples of this are dogs helping the blind, the deaf, in therapy, and for diabetic/ seizure alert. If a student views a video of a dog prior to taking a test, then will the student have a lower heart rate than someone who did not? The qualitative data of the dependent variable will be the video of the dog, as well as if the students appear more relaxed. The quantitative part of the dependent variable is the students heart rate. The independent variable will be the students with the video (the video can vary). The control group will be the group of students without any video. There will be four groups of students. One is the control, one has a video of a baby, the second is a video of a dog, and the other is a video of a monkey. These were chosen because there is a chemical in the human brain that creates a feeling of happiness when seeing a baby and a puppy. The monkey was chosen because humans respond to things and animals that have similar qualities and habits. The heart rate of each student will be taken before and after they will be taking a test, as well as after watching the video. The control won't receive a video. For each group and category (type of video), the means of the data will be collected and compared. This will conclude if after watching a video whether or not the students will exhibit less stress, measured through heart rate.

Amity Regional High School
Catherine Piscitelli, Teacher

Mina Kim**Project #233**

Research Proposal, Science, Environmental

Impact of Varying Water pH levels on Growth of Different Species of Bean Plants

There are many factors that optimize growth of various bean plant species. One such factor is the pH level of the water. Some plants prefer acidic conditions and others prefer basic. For example, hydrangeas prefer to be watered with slightly acidic conditions while lilacs prefer alkaline soil. This is important for gardeners and farmers because knowing the optimal pH level of the water will maximize plant growth. Generally, bean plants prefer more acidic conditions of growing (soil pH level of 6-6.8). Because minerals are more soluble, microorganisms are more active and nutrient uptake improves. Do different pH levels of the water affect the Phaseolus bean plant growth? If the pH level of the water is varied, then the acidic pH level water will cause the plant growth to be taller. The independent variable is the pH levels of the water and the dependent variable is the Phaseolus bean plant growth (cm) of different species. There will be 9 cups and in each cup, it will be filled with the same soil and same amount of bean plant seeds. Three different species of bean plants (Phaseolus vulgaris, Phaseolus lunatus, Phaseolus coccineus) will be used in each of the three sets. Each set will be watered with different pH levels of water (pH 6.0, 7.0, and 8.0).. Plant growth will be measured at the same time. The highest plant growth will indicate the best pH level the plant should grow in.

Amity Regional High School
Catherine Piscitelli, Teacher

Akanksha Paul

Project #234

Research Proposal, Science, Health and Medical

The Effect of ASMR Experiences on Stress Levels

Autonomous Sensory Meridian Response (ASMR) is a term used to describe a mysterious and euphoric tingling sensation people have in response to various stimuli. The tingling usually starts in the scalp and makes its way down the neck and spine to the rest of the body. It often induces feelings of relaxation. Research has proven that relaxation is a significant factor in reducing stress levels. Keeping this in mind, this study's objective is to test how ASMR experiences have an effect on the stress levels of individuals. The independent variable is the type of ASMR trigger that is used. The dependent variable is the stress level of each participant after encountering ASMR. It is believed that if people are exposed to different ASMR triggers, then their stress levels will be reduced after. This will be tested by recording the stress levels of the test subjects quantitatively through their heart rates using a heart rate app and qualitatively through a questionnaire before the trials. There will be four experimental groups; one will poke slime, one will mix paint, one will cut kinetic sand, and the last one, the control group, will rearrange sticks into a picture. All of the people in each group will experience their ASMR trigger and be tested afterward for their stress levels using the heart rate app and the questionnaire.

Amity Regional High School
Catherine Piscitelli, Teacher

Kayla Morgan

Project #235

Research Proposal, Science, Environmental

The Effect of Soil Composition on the Growth of Different Plants

Scientists know little about how differences in the soil and other environmental factors influence the different plants that grow in the different parts of the riparian environments. With more knowledge on freshwater wetlands we may be better able to preserve and restore these wetlands to promote the security of the highly diverse species of plants and animal that live there and make a more stable ecosystem. The question trying to be answered is, how does the mineralogy of soil affect the plant growing in it? The independent variable will be the type of plant and the type of soil it is growing in. The dependent variable will be the linear plant growth. The control group will be the plant growing in its native soil. It is hypothesized that if soil composition varied then it will affect the plant growth depending on the plant type. Plant 1 will be grown in its native soil and in plant 2's native soil and vice versa. The two plants that are going to be grown are the black willow and white maple tree. The forty plants will receive equal amounts of sunlight and they will be watered 0.8 cubic inches per day per plant. To analyze the soil for the types of minerals a sample of the soil will be sent to a place with an x ray diffractor. The data will be recorded in a height vs time graph. It will also be analyzed to see how the mineralogy of the soil affected the type of plant growing in it.

Amity Regional High School
Scott DeMeo, Teacher

Sienna Wang**Project #236**

Research Proposal, Science, Behavioral

The Effect of Natural and Processed Foods on Adolescents' Memory Retention

Do natural or processed foods affect adolescents' memory retention more? It is hypothesized that if the type of food consumed is related to adolescents' memory retention, then natural foods will benefit adolescents' memory retention more than processed foods. The independent variable is the healthy or unhealthy food eaten by the subjects. There is no control group. The dependent variable will be the average score in percent on the memory retention tests. Participants will be adolescents. Subjects will be split into two groups and will participate for a total of 5 days. They will be tested on memory retention. Participants will be put into separate rooms at the same time each test is run. They will use the same computers and take the same tests. They will keep a food log to see the food and beverages the participant consumed. The participant will take the test for 5 days and be scored on how well the subject did. The first section is an article and will only be given on Day 1 of the testing and will be given for 10 minutes. For the other 4 trials, participants will only be given the second section, which is multiple choice. The participant will be given five different questions for each test. Data will be graphed and analyzed to determine relationships between the different types of food and memory retention. The data will compare the averages the healthy and unhealthy groups had on the test. The resulting conclusion will then be used to determine which type of food enhances memory the most and can be used by adolescents when learning to increase productivity.

Amity Regional High School
Scott DeMeo, Teacher**Martin Gnidula****Project #237**

Research Proposal, Science, Environmental

Effects of Mannitol on the Growth and Development of the Wisconsin Fast Plant

The growth and development rate of plants are a set ratio of time and nutrients. Due to the increased nutrient consumption that can be caused, mannitol may be able to make a big difference on a plant's growth and production. Mannitol is an organic chemical found in seaweed that is used in many functions as a way to improve osmotic stress rates. This experiment will examine the effects of a mannitol used alone or with conjunction with a 16-16-16 ratio fertilizer on the growth and development rate of the Wisconsin Fast Plant. It is hypothesized that if a Wisconsin Fast Plant is given an amount of fertilizer containing mannitol with a 16-16-16 ratio fertilizer, then the growth and development of the Wisconsin Fast Plant will be superior to the growth of the plants that no fertilizers. The independent variable will be the use of the mannitol with and without the 16-16-16 fertilizer. The dependent variable will be the dry matter yield of the plants. The control will be Wisconsin Fast Plants grown without any fertilizer or enhancer. The first testing group will be the Wisconsin Fast Plant grown with mannitol and soil. The second testing group will be grown with the 16-16-16 fertilizer and mannitol. The third testing group will be the Wisconsin Fast plant grown in 16-16-16 fertilizer and no enhancer. The growing area will be set up and the plants will grow. The plants will receive the mannitol and fertilizer once the plants germinate. After growing the plants' dry matter yields will be measured. The conclusion will be deemed by comparing the total and mean of the dry matter yields from the testing groups and the control.

Amity Regional High School
Scott DeMeo, Teacher

Nicole Mongillo

Project #238

Research Proposal, Science, Behavioral

The Effect of Sleep Duration on the Humor Perception of Freshmen in High School

Sleep duration has been proven to have effects on the emotional and mood regulations of adolescents. Based on this, this experiment will examine the effects of sleep duration on the perception of humor in freshmen. The independent variable will be the amount of sleep each individual gets on a nightly average for three weeks. The dependent variable will be the person's perception of humor. It is hypothesized that if adolescents in the freshman year of high school get 6-8 hours of sleep on a nightly average for 3 weeks, then they will perceive humor to be funnier than the adolescents getting more or less amounts of sleep. Adolescents will track how much they sleep per night over a three week period. The total number of hours they slept over the last three weeks of the tracking period will be averaged on the test date before the test. The teens will then hear the same audio of a person telling jokes. Each will rate how funny they perceived each joke to be. Results will show how different amounts of sleep in adolescents can affect their perception of the humor level of jokes. This can be used to help professionals instructing freshmen to better understand whether or not the use of humor in a learning area is beneficial in the classroom. The experiment could also be useful to freshmen. If they understand that sleep has an effect on their peer's perception of humor, then they can understand that their reaction to humor may not be a reflection of the funniness of something, but a reflection of how much sleep they have gotten.

Amity Regional High School
Scott DeMeo, Teacher

Julia Todeasa

Project #239

Completed Project, Engineering, Environmental

Comparing the efficiency of water-filtering materials and developing an affordable, effective, water filtration system for the developing world

About 3.5 million people die annually in the developing world from water-borne pathogens. The actions that are being taken to solve this crisis are insufficient. Thus, to take part in providing a workable solution, this project will focus on the development of a small, low-cost, water filtration system that can be easily distributed to inhabitants of the developing world. Four filters will be constructed; one made of zeolite, one of activated carbon, one of regular graphene, and one of high-quality oxidized graphene. All are known to be effective filtration media for all types of contaminants. The materials will be placed in a funnel with glass fiber paper and coffee filter paper for more support. Each filtration system will be tested and compared to find which material was to most cost effective. Water samples contaminated with mud, food coloring, and iron chloride (one contaminant per sample) will be passed through each filter. We will compare immediate changes in water color, pH, and flow rate. A couple drops of samples of the muddy water will be dried on microscope slides and examined under a scanning electron microscope for sediment and plant material. Graphene is hypothesized to be the most efficient, but activated carbon will be the most cost effective and the optimal choice. There are many efforts being taken to increase access to clean, drinkable water, but many of them aren't as effective as they should be to end the major problem. A small, personal filter that removes all types of contaminants from water could change the world. The filters can be affordably distributed to the millions of people in developing areas that are affected by contaminated, unclean water.

Amity Regional High School
Deborah Day, Teacher

Howard Ding

Project #240

Completed Project, Engineering, Environmental

Residential Oil Tank Risk Prediction

Fuel tank leaks are an environmental and economic issue. From fires to explosions to pollution, oil spills can bring dangerous consequences with cleanup costs reaching into the hundreds of thousands or millions depending on the size and scope. With a lack of general public recognition, consumers may be unaware of the danger and risk of leaking oil tanks and do not realize until it has spilled. This study aimed to predict the expected life span of residential oil tanks by inputting oil tank information collected locally from homeowners. This was accomplished using Google Forms where the data can be directly put into a spreadsheet along with photos that were then analyzed for the condition of the tanks. A risk prediction model was created using the survival package of the statistical programming language R. This model can increase the amount of public awareness and hopefully reduce the amount of spills that occur due to the recognition of the potential replacement time of a tank. It was found that a typical residential tank could should be replaced around the 30 year mark due to the age of it, but not due to the potential for leaks. The use of tanks that have already leaked to provide risk factors were not used, contributing to the rawness of this method of analysis at this stage. This data can be used for public awareness on the risk of all oil tanks, whether managed well or not. It can also be used as a model to move to larger scale studies involving more specific data with more data points to provide better insight into this issue.

Amity Regional High School
Deborah Day, Teacher

Suvasini Balaji

Project #241

Completed Project, Science, Health and Medical

Evaluation of Potential Outer Membrane Protein Candidates for the Serological Diagnosis of Leptospirosis

Leptospirosis is a bacterial disease, caused by the leptospira bacteria, that affects humans and animals and has a wide range of symptoms. Without appropriate diagnosis and treatment, leptospirosis can lead to kidney damage, meningitis, liver failure, respiratory distress, and even death. The objective of this study, therefore, was to find an improved method of the early diagnosis of leptospirosis using an enzyme-linked immunosorbant assay (ELISA). This involved testing five protein candidates, derived from the leptospira bacteria, that were previously determined to generate an immune response in humans. With the recombinant proteins, ELISA plates were prepared and used with sera from human patients with confirmed leptospirosis (those in the acute and convalescent phases of the disease) and from a control group of healthy individuals (both living in the endemic site in Brazil and in non-affected regions). The conducted ELISAs determined if confirmed case patients raised antibodies against these proteins, and what concentrations of the proteins could be used to differentiate confirmed cases/people who had contact with the agent from those who are healthy. By comparing the optical densities from plate wells with positive and negative sera for each protein, the most effective proteins and their concentrations were honed in on. Overall, this project will help to determine if these proteins are good candidates that can be used in future point-of-care assays for an early diagnostic of leptospirosis. In the long run, this is hoped to allow for a diagnostic of leptospirosis that can be used in regions without ample medical resources.

Amity Regional High School
Deborah Day, Teacher

Shiva Gowda

Project #242

Completed Project, Science, Health and Medical

Investigating the Role of Lung Cancer Screening in the Cessation of Smoking

Lung cancer screening can detect malignant diseases early on and treat them before they become a major problem. However, smokers enrolled in screening may see no risk in smoking because if any signs of malignancy is detected, the patient can be treated right away. This project is designed test whether lung cancer screening is more beneficial than not, and whether screening is correlated to smoking cessation. It is hypothesized that the majority of patients enrolled in screening will have stopped smoking on a daily basis a year after screening. To test this, 46 patients who were smokers one year ago will be surveyed via phone to determine whether or not screening is a cause of smoking cessation. The people being surveyed stated prior to screening that they wanted to quit smoking or were on the borderline of doing so. After obtaining the data, logical analysis of the survey questions will determine whether Lung Cancer Screening is a cause of smoking cessation. In addition to the hypothesis, it is contended that over 50% of participants will have quit smoking a year after and will identify that screening is more beneficial than not. Lung Cancer screening is starting to be instituted more in hospitals, however there is still some hesitation as to whether it is completely beneficial. Because of this lack of knowledge, hospitals may not be using screening as effectively as they could. This study will determine whether screening is beneficial in that it increases smoking cessation. The results from this experiment will provide doctors insight as to how often screening should be implemented.

Amity Regional High School
Deborah Day, Teacher

Kevin Yanagisawa

Project #243

Completed Project, Science, Environmental

The Comparison of Metal Absorption of Microparticles from Various Face Washes

In recent news, microplastics and microbeads have shown to be a serious issue that must be addressed immediately. Currently, there is an ongoing call to “Ban the Bead” because of their property to absorb heavy metals and other toxins, which get biologically magnified, and possibly make their way back to humans in the form of fish and other consumables. First, the microbeads are extracted from the facial washes by using a nylon mesh and 18 megaohm water. The mesh is thoroughly cleaned before each sieving. After, the beads are dried then analyzed to see their composition. Once analyzed, they will be exposed to liquid suspensions containing lead, zinc, copper, and tap water. They will be left to absorb the liquid for 1 week, then examined under a mass spectrometer. An Inductively Coupled Plasma Mass Spectrometer will be used to analyze the contents of each microbead. The average amount of each element within the microbead will be charted and graphed. In depth research on the topic of microbeads and the effects it has on biomagnification, as well as the effects it has on the environment, is relatively new. This project can show if natural microbeads are better, worse or make no difference in metal absorption when compared to plastic microbead absorption.

Amity Regional High School
Deborah Day, Teacher

Joseph Benedetti
Austin Gilbride

Project #244

Research Proposal, Science, Environmental

The Effect of Predation and Availability of Resources on Habitat Selection of Oniscus asellus

The purpose of this experiment is to identify the preferred location of *Oniscus asellus* in an ecosystem with different amounts of resources available to them. Also, there will be predator in the environment with a greater amount of food. We found our motivation through prior research that our mentor had done regarding the different respiratory rates of Isopods due to stresses such as a predator in their environment. In this experiment we will set up different environments with varying amounts of resources given on a scale from 10-100% with increments of 10% increasing. In each of these environments a divider will be placed to separate either side of the environment, the predator side and the non-predator side. The experiment will go on for four days and will be recorded using a GoPro. Since the spider is potentially dangerous, precautions will be taken by wearing gloves and using a sign to make sure no staff accidentally opens the spider cage. The projected results of the experiment are that the Isopods will favor a habitat without a predator when the habitat has 60% of the resources. This is due to the giving up density graph which represents the starving saturation points. The giving up density graph has two intervals. The first interval, from 0 to 50 represents the starvation point, and from 60 to 100, represents the saturation point. This project is made to learn more about the foraging and habitat selection behaviors of isopods, and having better knowledge of determining the decomposition rate based off the number of predators in the area, affecting number of Isopods in the area. There are also the implications of determining where to find Isopods in the environment, based off number of predators and amount of food in the ecosystem.

Amity Regional High School
Deborah Day, Teacher

Julia Nadelmann

Project #245

Completed Project, Science, Behavioral

Investigating Cooperation in the Sharing Economy through the WiFi sharing Game

The purpose of this study is to investigate what factors, impact how individuals cooperate in a sharing economy. For this study, individual participants will engage in an online WiFi sharing game with other participants, in which each participant is a resident of different nearby house, each with a Wi-Fi connection of a certain bandwidth. When a participant is not home, they have the ability to share their Wi-Fi with their neighbors, and in return one's neighbors can share their internet with other participants when they are not home. The more Wi-Fi bandwidth a participant has received from their neighbors, the faster their internet connection will be, and the larger their score will be at the end of the game. The independent variable in the experiment was the different information that is shown to the players prior to deciding, to investigate how awareness of other players wealth, and previous sharing behavior impact cooperation and sharing decisions. There were four treatment options in this experiment. At the end of every game there was a survey conducted to assess satisfaction with one's neighbors well as the players' strategy. Data is still being collected through trials of the game, all trials are expected to be completed by early February

Amity Regional High School
Deborah Day, Teacher

**Identification of Meat Species in Pet Foods
Using Polymerase Chain Reaction (PCR)
to Detect Mislabeling**

DNA Barcoding is a way to identify species that one could not necessarily identify with the naked eye. It is a method that uses a genetic marker in an organism's DNA to determine to what species the organism belongs. This method will allow us to unveil the truth of what both cats and dogs are really consuming from various popular brands of premium pet foods. In this study we will collect samples from different entrees of specific cat and dog food companies. We will then extract the DNA from the samples and amplify it with Polymerase Chain Reaction (PCR) using the appropriate primer and a thermal cycler. The PCR products will then be confirmed using gel electrophoresis and sent out for sequencing. The sequencing results will then be analyzed, allowing us to find out whether the entree products are mislabeled or not. By using the DNA Barcoding process, we predict that we will come across mislabeling of the main ingredient in meat - and fish - based products. After finding the results, we intend to reveal the truth about the authenticity of the various companies. The results of this study will imply to the public that mislabeling of pet food products does occur and while there are some reliable pet food companies, there are other ones that are not as reliable. Therefore, it is suggested that consumers need to make careful decisions regarding pet food purchases.

Convent of the Sacred Heart
Mary Musolino, Teacher

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