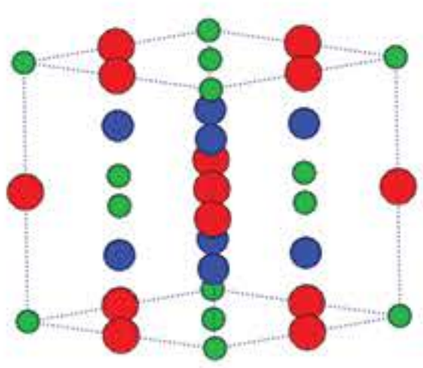
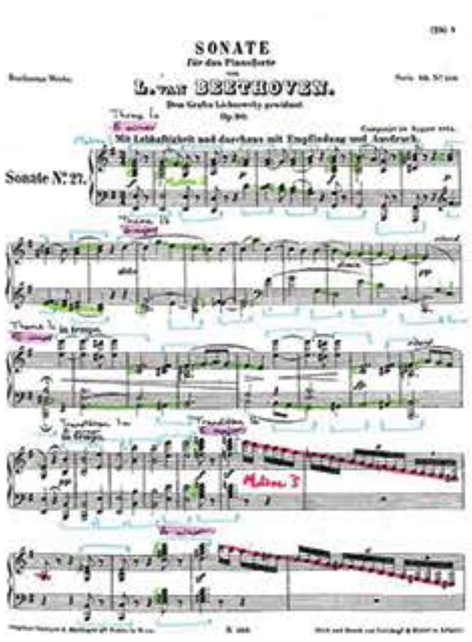
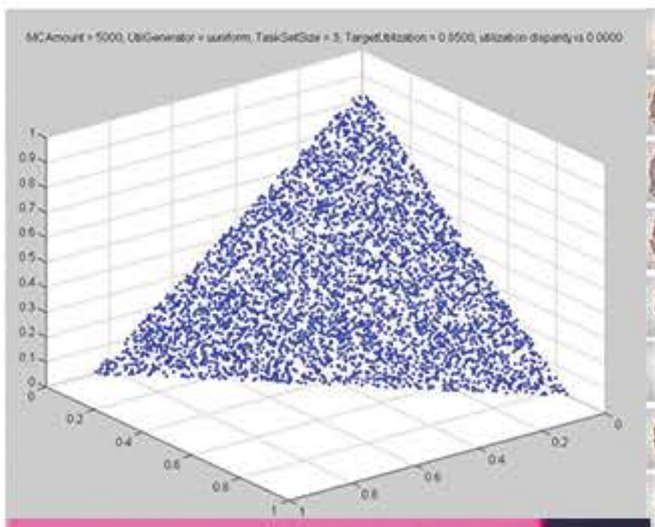
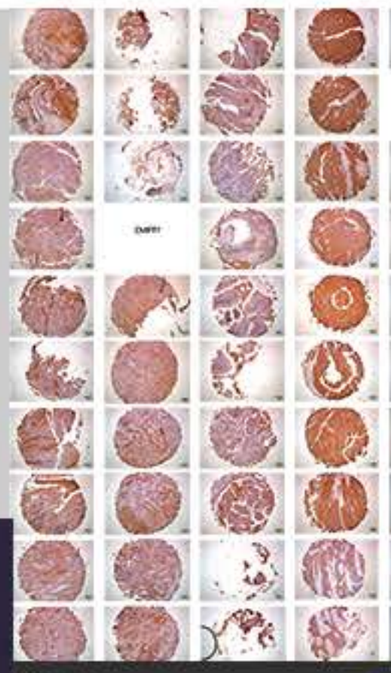
IMSAloquium

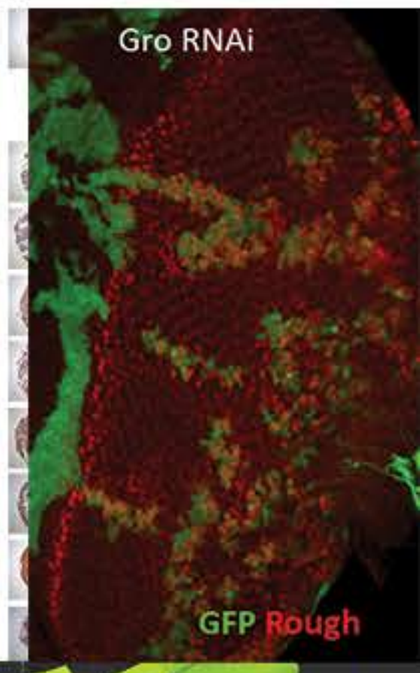
STUDENT INVESTIGATION SHOWCASE

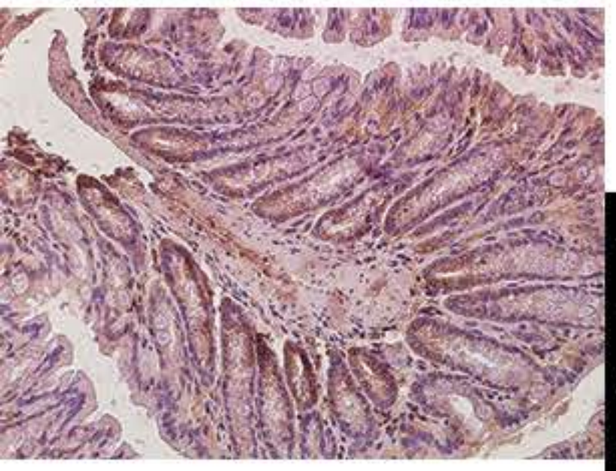


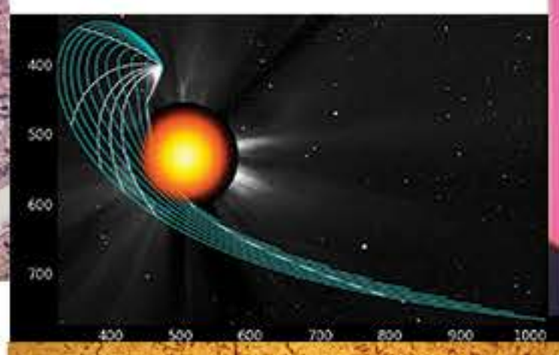


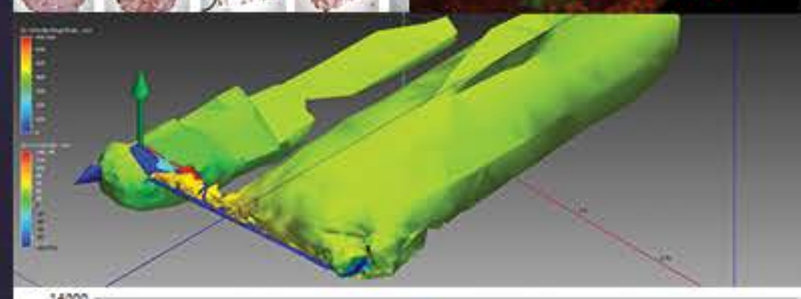


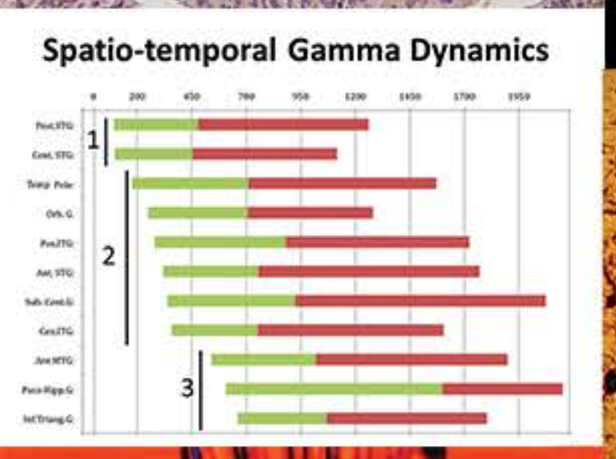












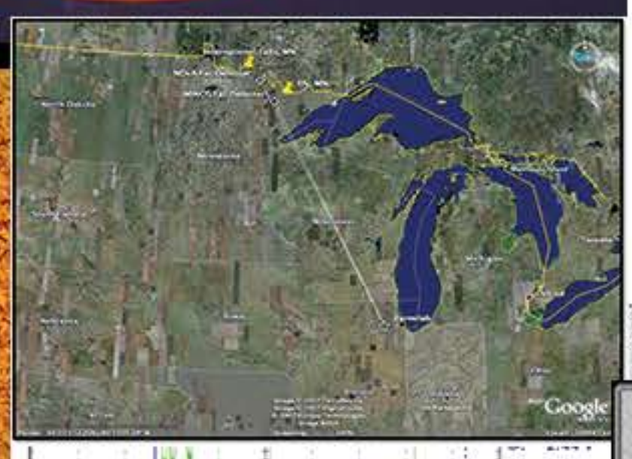
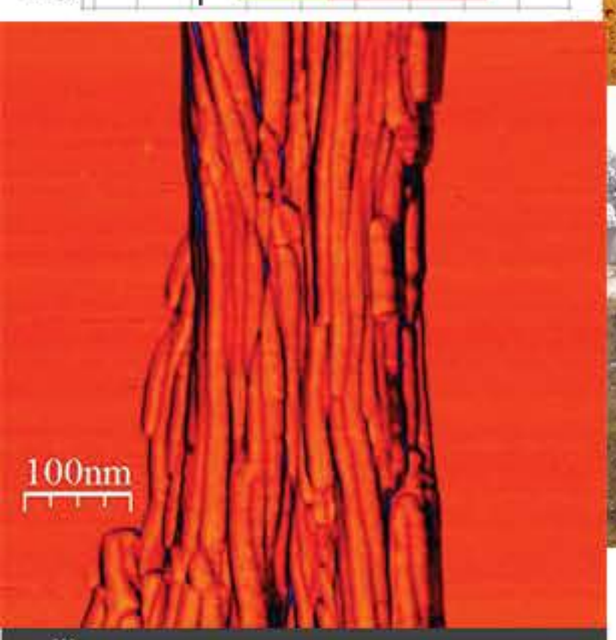
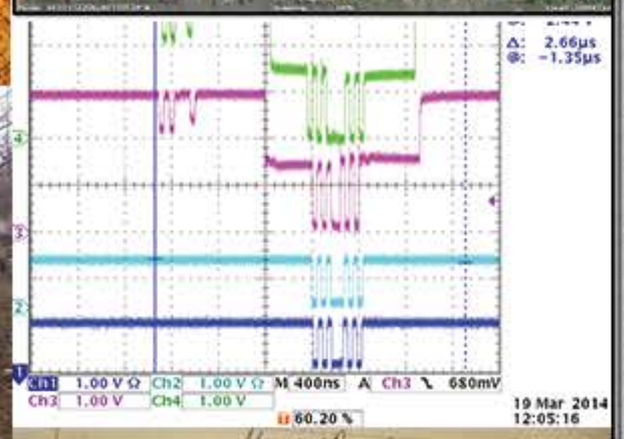
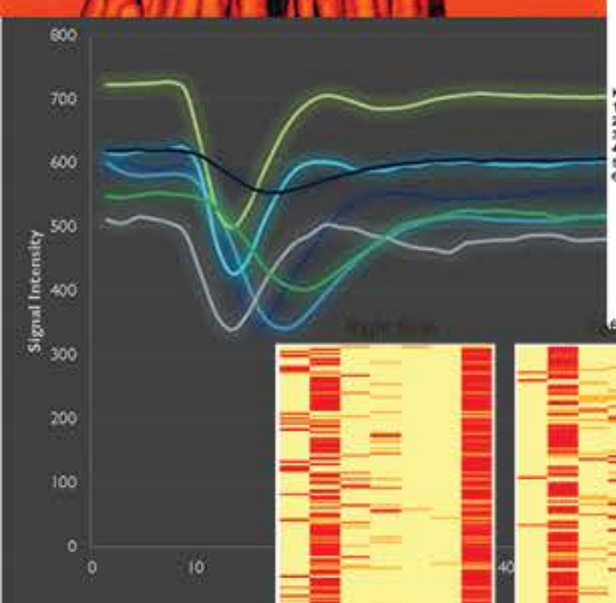
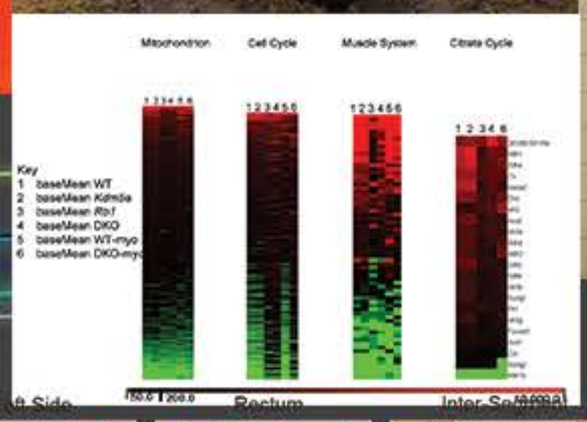


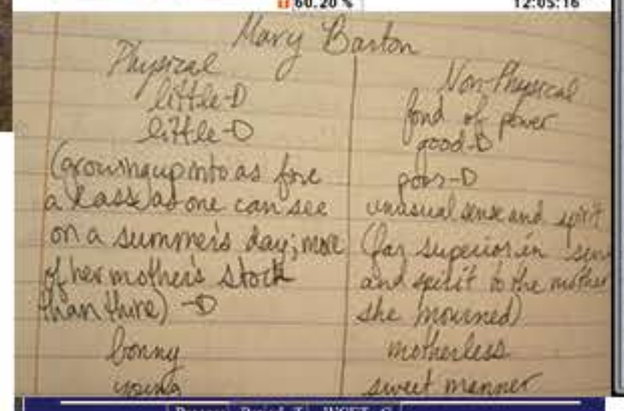
Figure 1.
Graphs the total number of articles published per month by a variety of news corporations. Blue represents the Chicago Tribune, red represents the New York Times, green represents the Chicago Sun-

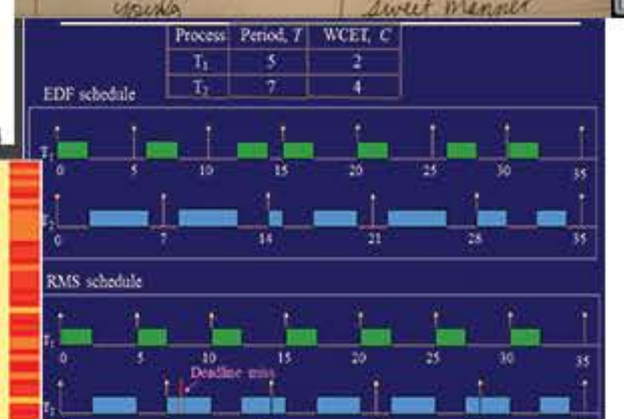












April 30, 2015
www.imsa.edu

IMSAloquium
STUDENT INVESTIGATION SHOWCASE

April 2015

Dear IMSA Friends:

Welcome to the twenty-seventh year of the Student Inquiry and Research Program (SIR)! Our IMSA students continue to demonstrate excellence in all fields, pursuing investigations into their unique passions, exploring new interests, and demonstrating their ability to both ask and answer deep and meaningful questions.

Evidence of our mission "to ignite and nurture creative, ethical, scientific minds that advance the human condition" is demonstrated within the pages of this abstract book. IMSA students pursue compelling questions of interest, conduct investigations, communicate findings, and ultimately impact society and the global community through their SIR investigations. Our students gain experience in real-world problem solving, collaboration, and scholarship by partnering with distinguished professionals at colleges and universities, research institutions, businesses, and museums.

The ability to work with professionals is a life-changing experience for our students. Working with world-class scholars and advisors, students conduct high-level research fitting a world-class institution, contributing to advances in a variety of fields from science, technology, engineering, and mathematics, to the performing arts and history. In fact, a number of our students have already published and presented their work at state, national, and international conferences.

We want to express our gratitude for the generosity and steadfast support of all the experts and leaders who have nurtured our remarkable students this year. These collaborative partnerships are the strength of our SIR program. Advisors' commitment to guiding our students has allowed them to attain exceptional levels of achievements. IMSA students are well-prepared to confront and solve present and future challenges that face our local and global communities.

Please join us in celebrating our students' extraordinary research accomplishments!

Sincerely,

Judith A. Scheppler, Ph.D.
Coordinator of Student Inquiry and Research

José M. Torres, Ph.D.
President, IMSA

Illinois Mathematics and Science Academy
The World's Leading Teaching and Learning Laboratory for Imagination and Inquiry

Twenty-seventh Annual IMSAloquium
April 30, 2015

Table of Contents

IMSAloquium cover design is a compilation of figures and images from the work of past SIR students. It was completed using Adobe PhotoShop.

IMSAloquium logo design by Stephanie Chang and Hon Lung Chu (IMSA Class of 2007).

Twenty-Seven Years of Student Inquiry and Research

The Student Inquiry and Research (SIR) program has been an integral part of student personalized learning at IMSA since the 1989 academic year. Since its inception with seven students, SIR has grown into a program that encompasses all disciplines, includes nearly three hundred participants each year, and participation by each graduating class has grown to about 90%. Credit is now offered for participation in SIR in the summer, and Summer SIR continues to grow.

Our students' accomplishments have flourished. They do not have to wait until they graduate from college to begin to make significant contributions to science, mathematics, the humanities, and the world around them. IMSA's young apprentice investigators open our eyes to what is possible, and the World is paying attention. Accomplishments by students participating in Student Inquiry and Research are numerous! Representative publications, presentations, and accomplishments are listed below.

Authorship or Co-authorship in Publications (partial listing)

- *Information Processing Letters*
- *Journal of Vacuum Science and Technology B*
- *Nature*
- *The Open Virology Journal*
- *Young Scientist Journal*

"**Student Inquiry and Research: Developing Students' Authentic Inquiry Skills**" authored by Judith A. Scheppler, Susan Styer, Donald Dosch, Joseph Traina, and Christopher Kolar, is among only eighteen inquiry-based programs nation-wide to have a chapter in the National Science Teachers Association book *Inquiry: The Key to Exemplary Science* (2009, NSTA Press).

"Student Inquiry at the Illinois Mathematics and Science Academy," authored by Judith A. Scheppler, Donald Dosch, Susan Styer, and Steve Rogg, is among only fifteen high school models in the nation to have chapters in the National Science Teachers Association book, *Exemplary Science in Grades 9-12* (2005, NSTA Press).

Portraits of Great American Scientists (2001, Prometheus Books) contains biographies of fifteen American men and women motivated to excel in diverse fields of science. This book was the collaborative student effort of fifteen participants in IMSA's Student Inquiry and Research Program.

Presentations (brief listing)

- American Physical Society
- American Society of Microbiology
- 10th Annual Dabrowski Conference
- IEEE Ninth Workshop on Spatial Stochastic Models for Wireless Networks
- International Student Science Fair
- Junior Academy of Science at AAAS

Competitions (brief listing)

- Intel International Science and Engineering Fair
  - 26 finalists since 2008
  - 3 fourth place (individual) category awards, 1 (team) third place category award
- Intel Science Talent Search
  - 47 semi-finalists and 13 finalists since 1989
  - Finalists have placed first (1993), fifth (1998), third (1999), and second and sixth (2005)
- Siemens Westinghouse (established 1998-99)
  - 59 regional semi-finalists; 9 regional finalists, resulting in 1 national semi-finalist

2014-2015 Student Recognition

Please join us at 12:30 in the Academic Pit to celebrate the accomplishments of our students.

Jorge Isaac Adorno: Innate Learning: Training the Brain Before the Eyes Open
Advisors: Mark Albert and Gordon Kratz, Loyola University
Student presentation at the Chicago Python programmers group, November 13, 2014, Chicago, IL

Timothy Akintilo: Development of a Quantitative System for Evaluating At-Home Standing of the Mobility Disabled
Advisors: Arun Jayaraman, Luca Lonini, and Timothy Reissman, Rehabilitation Institute of Chicago
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia

Marissa Brock: The Correlation Between Exercise and Stress of Adolescents in Academically Rigorous Environments
Advisors: David Lundgren, Illinois Mathematics and Science Academy; and Jay Thomas, Aurora University
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Kristin Carlson: Alteration of Brain Connections in Resting State Networks After Performing Simple Motor Actions
Advisors: Todd Parrish and Xue Wang, Northwestern University
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Catherine Chen: Effects of Antibiotics on Gastrointestinal Motility and Gut Microbiota
Advisors: Eugene Chang and Ketrija Touw, University of Chicago
40th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Health Science, special award from the US Public Health Service

Felicia Chen: The Impact of Gender Ratios on Student Performance
Advisor: Joseph Traina, Illinois Mathematics and Science Academy
Illinois Junior Academy of Science, Region V Project Exposition special award from the US Navy

Jason Chen: Modeling HSV-1 Transmission to Determine Antiviral Efficacy of Zinc Oxide Nanoparticles
Advisors: Dinesh Jaishankar and Deepak Shukula, University of Illinois at Chicago
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Cellular and Molecular Biology/Microbiology

Nicholas Damen: Distinguishing Meningiomas With b-Value DWI and Fractional Order Calculus Model
Advisors: Frederick Damen, Yi Sui, and Xiaohong Joe Zhou, University of Illinois at Chicago
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Amy De La Torre: The Invisible Social and Emotional Struggles of Women in Law Enforcement and the Military
Advisors: James Bondi, Illinois Mathematics and Science Academy, and Kristen Ziman, Aurora Police Department
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Grace Duan: Active Brain Regions During Sleep Using Electroencephalography-Functional Magnetic Resonance Imaging
Advisor: Todd Parrish, Northwestern University
*Presented at and coauthor of presentation at the 100th Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 30 - December 5, 2014, Chicago, IL (**Grace Duan**, **Sameeksha Malhotra**, Todd Parrish); Poster and presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 11-15, 2015, in San Jose, CA*

Nathan Errampalli: Amyloid Precursor Protein and Amyloid-β Oligomer Concentrations are Connected in Developing Chicken Embryos
Advisors: Maira Bicca, William Klein, and Kirsten Viola, Northwestern University
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Ryan Franks: Surface Modification of Silica-supported Ti(IV) and Nb(V) Oxides for Understanding Reactivity and Stability in the Epoxidation of Alkenes with H_2O_2
Advisors: Justin Notestein and Nicholas Thornburg, Northwestern University
*Coauthor of presentation given at the 2015 American Chemical Society meeting, March 22-26, Denver, CO (Nicholas E. Thornburg, **Ryan E. Frank**s, Justin M. Notestein)*

Geronimo Garcia: Examining Cell-Cell Communication in Filamentous Cyanobacteria Using Electron Tomography
Advisors: Robert Haselkorn and Amin Nasser, University of Chicago
Poster presented at the STEM Summit, November 5, 2014, Northwestern University. Evanston. IL

Angad Garg: Modeling HSV-1 Transmission to Determine Antiviral Efficacy of Zinc Oxide Nanoparticles
Advisors: Dinesh Jaishankar and Deepak Shukula, University of Illinois at Chicago
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Cellular and Molecular Biology/Microbiology

Ashu Gupta: Creation of a Methane Sensor by ZnO ALD Functionalization of Carbon Nanotubes
Advisors: Ralu Diva, Tanim Humayuan, and Leo Ocala, Argonne National Laboratory
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], special award from the ASM Materials Education Foundation

Evania Hong: A Cross-Cultural Study of the Relationship Between Empathy and Social Dominance
Advisors: Joan Chiao, Northwestern University, and Vandana Chinwalla, Illinois Mathematics and Science Academy
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia

Alyda Huerta: CRISPR/Cas9 RNA-Guided Upregulation of Utrophin as a Therapy for Duchenne Muscular Dystrophy
Advisors: Renzhi Han, Andrew Mariano, and Audrey Torcaso, Loyola University
Poster presented at the Japan Super Science Fair (JSSF), November 6 - 13, 2014, Kyoto, Japan

Varun Iyer: Modeling of Supernovae Neutrino Interactions Through Neutrino Event Generation
Advisor: Gabriel Perdue, Fermi National Accelerator Laboratory
Illinois Junior Academy of Science, Region V Project Exposition special award from Intel Computer Science and the US Airforce

Divya Jasthi: The Correlation Between Neonatal Disease Severity and the ABO Blood Type
Advisors: Jonathan Muraskas, Renae Reisig, and Mary Stuchly, Loyola University
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Health Science

Emily Jia: Unitary Representations of the Braid Group on Three Stands
Advisors: John Boller and Niels Nygaard, University of Chicago
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Physics

Alexandra Johnson: The Correlation Between Exercise and Stress of Adolescents in Academically Rigorous Environments
Advisors: David Lundgren, Illinois Mathematics and Science Academy; and Jay Thomas, Aurora University
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Sharon Johnson: The Correlation Between Gestational Age and Independent Oral Feeding in Preterm Newborns
Advisors: Jonathan Muraskas and Sarah van Nostrand, Loyola University
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Omair Khan: Burn Injury Alters the Intestinal Microbiota and Increases Inflammation and Risk of Sepsis
Advisors: Mashkoor Choudhry, Zackary Earley, and Xiaoling Li, Loyola University
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY; Presented at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 11-15, 2015, in San Jose, CA

Gene Kim: Designing an Augmented Reality Particle Detector to Show Neutrino Interactions
Advisors: Benjamin Carls, Alistair McLean, and Geralyn Zeller, Fermi National Laboratory
Illinois Junior Academy of Science, Region V Project Exposition special award from the Yale Science and Engineering Association

Nisha Kishore: The Emotional Intelligence of Illinois Mathematics and Science Academy Students
Advisors: David Evenson and Christopher Kolar, Illinois Mathematics and Science Academy
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia; Poster Presentation and Student Panelist at the STEM Summit, November 5, 2014, Northwestern University

Sweta Kotha: The Impact of Gender Ratios on Student Performance
Advisor: Joseph Traina, Illinois Mathematics and Science Academy
Illinois Junior Academy of Science, Region V Project Exposition special award from the US Navy

Sanjay Kottapalli: Evaluating Molecular Function of Proteins Through Integrase-Mediated Cassette Exchange
Advisors: Debabrata Chakravarti and J. Brandon Parker, Northwestern University
Poster and presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 11-15, 2015, in San Jose, CA;

Niresh Kuganeswaran: Genetic Comparison of High- and Low-Level Nitric Oxide Cancer Cells With Gene Co-Expression Networks
Advisor: James Radosevich
*Co-author of abstract presented at the National Conference on Pure and Applied Chemistry, December 29-31, Mysore, India (James. A. Radosevich, **Rish Kuganeswaran**, Crystal Luna, Zana Deliu, Dana Hamed, Madeeha Aqil, Abdallah Al Oweidi, Maryam Khalili, and Maaly Bassiony); coauthor of poster presented at UIC's Annual Clinic and Research Day, March 5, 2015 (Abdallah Al Oweidi**, Niresh Kuganeswaran,** Crystal Luna, Zana Deliu, Dana Hamed, Madeeha Aqil, Maryam Khalili, James A. Radosevich)*

Sophia Lam: The Correlation Between Gestational Age and Independent Oral Feeding in Preterm Newborns
Advisors: Jonathan Muraskas and Sarah van Nostrand, Loyola University
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Laura Lehman: The Invisible Social and Emotional Struggles of Women in Law Enforcement and the Military
Advisors: James Bondi, Illinois Mathematics and Science Academy; and Kristen Ziman, Aurora Police Department
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Faith Leslie: The Correlation Between Neonatal Disease Severity and the ABO Blood Type
Advisors: Jonathan Muraskas, Renae Reisig, and Mary Stuchly, Loyola University
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Health Science

Hope Leslie: The Correlation Between Neonatal Disease Severity and the ABO Blood Type
Advisors: Jonathan Muraskas, Renae Reisig, and Mary Stuchly, Loyola University
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1], Exemplary Project in Health Science

Vivian Liu: A Cross-Cultural Study of the Relationship Between Empathy and Social Dominance
Advisors: Joan Chiao, Northwestern University; and Vandana Chinwalla, Illinois Mathematics and Science Academy
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia

Rebecca Lisk: The Effect of Methylene Blue and Sodium Butyrate on the Motor Skill Retention and Cognitive Function of Fruit Flies with Alzheimer's
Advisor: Jacklyn Naughton, Illinois Mathematics and Science Academy
40th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Sameeksha Malhotra: Active Brain Regions During Sleep Using Electroencephalography-Functional Magnetic Resonance Imaging
Advisor: Todd Parrish, Northwestern University
*Co-author of presentation at the 100th Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 30 - December 5, 2014, Chicago, IL (**Grace Duan**, **Sameeksha Malhotra**, Todd Parrish)*

Monica Mastrud: Effect of Surface Characteristics of Lead Glass on the Ability to Collect Light in Calorimeters
Advisors: Anna Mazzacane, Fermi National Accelerator Laboratory; and Corrado Gatto, Istituto Nazionale de Fisica Nucleare (National Institute of Nuclear Physics)
Coauthor of poster presented at the Japan Super Science Fair (JSSF), November 6 - 13, 2014, Kyoto, Japan

Neal Modi: Resting-State Functional Connectivity of the Basal Ganglia as a Biomarker for Parkinson's Disease
Advisor: Todd Parrish, Northwestern University
*Presented at the ASNR 53rd Annual Meeting and Symposium, April 25-30, 2015, Chicago, IL (**Neal Modi**, Todd Parrish, **Lucy Yuan**, Xue Wang, Darren Gitelman, Tanya Simuni, Xiaowei Song); 40th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science, Region V Project Exposition Finalist*[1]

Sruti Mohan: The Effective Use of Biochar Water Filtration Systems for Third World Countries
Advisor: Jacklyn Naughton
Poster presented at the STEM Summit, November 5, 2014, Northwestern University

Emily Mu: Functions of Transcriptional Corepressor Groucho on Neuronal Differentiation
Advisors: Wei Du and Tianyi Zhang, University of Chicago
Siemens Semifinalist; Poster presented at the STEM Summit, November 5, 2014, Northwestern University; 2015 Fermilab Science Award

Luke Musgrave: Examining Influential Factors for Team Pitching Environments in Major League Baseball
Advisor: Christopher Kolar, Illinois Mathematics and Science Academy
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Paul Nebres: Designing a System for the Magnet Shimming Trials for Muon g-2 Project
Advisor: Brendan Kiburg, Fermi National Accelerator Laboratory
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]*, Exemplary Project in Physics*

Julian Pacheco: Association Between Diabetes-Related Single Nucleotide Polymorphisms and Various Cancer Types
Advisors: Brandon Pierce and Chenan Zhang, University of Chicago
Poster and presentation at the National Consortium for Specialized Secondary Schools in Science, Mathematics, and Technology Student Research Conference, July 13-16, 2014, Louisville, KY

Michael Qian: Amyloid Precursor Protein and Amyloid-β Oligomer Concentrations are Connected in Developing Chicken Embryos
Advisors: Maira Bicca, William Klein, and Kirsten Viola, Northwestern University
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Samuel Qian: Replicating Acetyl-CoA Carboxylase in Insect Sf9 Cells
Advisors: Piotr Gornicki and Robert Haselkorn, University of Chicago
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]*, Exemplary Project in Cellular and Molecular Biology/Microbiology*

Joy Qui: Electroanalytical Determination of Propranolol Using Flow Injection Analysis with Amperometric Detection
Advisors: D'Nisha Hamblin and Greg Swain, Michigan State University
40th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]*, Exemplary Project in Biochemistry/Chemistry*

Naren Radhakrishnan: Identification of Candidate Genes and Pathways in Autism
Advisor: Martin Forde, University of Chicago
Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]*. Exemplary Project in Cellular and Molecular Biology/Microbiology*

Aishwarya Raj: Analysis of Metabolic Pathways and the Relationship to Lysine (K)-Specific Demethylase 5A and the Retinoblastoma 1 Gene
Advisor: Elizaveta Benevolenskaya, University of Illinois at Chicago
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia; 2015 Sigma Xi Student Research Showcase; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]*, special award from the US Navy*

Sattvic Ray: 2015 Fermilab Science Award

Tavis Reed of IMSA's Class of 2016 won a gold medal in the NAACP's Dupage County Afro-Academic, Cultural, Technological and Scientific Olympics (ACT-SO) competition, in the categories of Chemistry/Biochemistry and Entrepreneurship. The ACT-SO competition gives top honors in Science, Business, Humanities, Performing Arts, and Visual Arts categories to encourage high academic and cultural achievement among African-American high school students.
The program features three components: mentoring, academic enrichment, and a local competition. Tavis was one of 11 students to win gold at the competition in late March, which took place in front of more than 600 parents, ACT-SO alumni, volunteers and program partners. This Gold medal makes Tavis one of 26 Illinois students to move on to the ACT-SO National Competition in Philadelphia this July. More information on the competition can be found on the NAACP website.

Aadit Shah: Analyzing the Presence of Immunosuppression Markers within the Tumor Infiltrating Leukocytes and Peripheral Blood Leukocytes of Glioblastoma Multiforme
Advisors: Rajwant Kaur, Andrew Parsa, and Christopher Williams, Northwestern University
40th Annual Chicago Region Junior Science and Humanities Symposium Finalist

Bhairvi Shah: Fiber Optic Interferometers as Acoustic Sensors for Bubble Chamber Dark Matter Detectors
Advisor: Eric Dahl, Fermi National Accelerator Laboratory
Siemens Semifinalist

Janani Sivakumar: A Hybrid Photometric and Spectral Algorithm for Efficient Detection of Gravitationally Lensed Quasars
Advisor: Sivakumar Muthuswamy, Motorola Solutions, Inc.
Siemens Regional Finalist; 53rd National Junior Science and Humanities Symposium 3rd Place Finalist, April 29-May 2, Hunt Valley, Maryland; 2015 Sigma Xi Student Research Showcase; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Pranav Sivakumar: A Hybrid Photometric and Spectral Algorithm for Efficient Detection of Gravitationally Lensed Quasars
Advisor: Sivakumar Muthuswamy, Motorola Solutions, Inc.
Siemens Regional Finalist; 53rd National Junior Science and Humanities Symposium 3rd Place Finalist, April 29-May 2, Hunt Valley, Maryland; 2nd place, Physics and Astronomy, 2015 Sigma Xi Student Research Showcase; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Pranav Sivakumar: Morphological Identification of Wide-Separation Gravitationally Lensed Quasars
Advisors: Brian Nord and Chris Stoughton, Fermi National Accelerator Laboratory
2014 International Google Science Fair finalist

Emma Sloan: Beam Test of the Muon g-2 Tracker
Advisor: Brendan Casey, Fermi National Accelerator Laboratory
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia

Lydia Stone: An Algorithm to Find the Height of a Multihop Wireless Network's Strip Yielding Maximum Efficiency
Advisor: Peng-Jun Wan, Illinois Institute of Technology
53rd National Junior Science and Humanities Symposium, Poster Session 5th Place Finalist, April 29-May 2, Hunt Valley, Maryland; Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]*, Exemplary Project in Physics, Special award from Mu Alpha Theta*

Mitchell Sun: Cumulative Toxicity of Oxaliplatin Resulting in Severe Sensory Polyneuropathy: A Case Report
Advisors: Susan Lis and David Ronen, Advocate Lutheran General Hospital
Co-author of poster presented at the AAPM&R 2014 Annual Assembly, November 13-16, San Diego, California and abstract published in the AAPM&R Journal, Sept. 2014, Vol.6, issue 9, S286-S287 (David Ronen, Michael P. Sibol, ***Mitchell Y. Sun****, Mark Lis, Carolyn Lis, Anna Lis, Leonard Klein); Illinois Junior Academy of Science, Region V Project Exposition special award from the Society for In Vitro Biology*

Rajani Sundar: Phthalates and Phthalate Alternatives: Effects on Proliferative and Estrogenic Target Genes
Advisors: Serdar Bulun and Ping Yin, Northwestern University
Poster presented at the International Student Science Fair, August 8-12, 2014, Moscow, Russia; *Poster and presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 11-15, 2015, in San Jose, CA*

Shelly Teng: The Effects of A4V Superoxide Dismutase 1 Mutant Protein Incorporation on Calcium Ion Membrane Conductance
Advisors: Michael Allen, Ana Correa, and Jacob Riehm, University of Chicago
Siemens Semifinalist

Rashmi Thimmapuram: The Role of Microglial Transient Receptor Potential Ankyrin 1 in Alzheimer's Disease
Advisor: Vernon Leo Towle, University of Chicago
40th Annual Chicago Region Junior Science and Humanities Symposium Alternate; 2nd place, Physiology and Immunology, Sigma Xi Student Research Showcase' Illinois Junior Academy of Science, Region V Project Exposition Finalist[1]

Priya Trivedi: Examining Cell-Cell Communication in Filamentous Cyanobacteria Using Electron Tomography
Advisors: Robert Haselkorn and Amin Nasser, University of Chicago
Poster presented at the STEM Summit, November 5, 2014, Northwestern University

Pranav Upadhyayula: The Effect of Mutations on an Individual's Response to Clopidogrel Using Big Data
Advisors: Prakash Upadhyayula and Sunita Upadhyayula
2015 Sigma Xi Student Research Showcase; Illinois Junior Academy of Science Region V Paper Exposition Finalis[1]

Sushil Upadhyayula: The Effect of Mutations on an Individual's Response to Clopidogrel Using Big Data
Advisors: Prakash Upadhyayula and Sunita Upadhyayula
2015 Sigma Xi Student Research Showcase; Illinois Junior Academy of Science Region V Paper Exposition Finalist[1]

Lucy Yuan: Using Functional Connectivity in the Basal Ganglia Network as a Biomarker for Parkinson's Disease
Advisors: Todd Parrish and Xue Wang, Northwestern University
*Poster and presentation at the Japan Super Science Fair (JSSF), November 6 - 13, 2014, Kyoto, Japan; Co-author of presentation at the ASNR 53rd Annual Meeting & Symposium, April 25-30, 2015, Chicago, IL (**Neal Modi**, Todd Parrish, **Lucy Yuan**, Xue Wang, Darren Gitelman, Tanya Simuni, Xiaowei Song); 40th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science, Region V Project Exposition Finalist*[1]

Huiran (Tina) Zhang: Comparing the Efficiencies of Electroporation, Chemical Transfection, and Transduction in MCF-10A Cells
Advisors: Abde Abukhdeir and Sanja Turturro, Rush University
40th Annual Chicago Region Junior Science and Humanities Symposium Finalist

[1]IJAS State Competition, May 1-2, 2015

ILLINOIS MATHEMATICS AND SCIENCE ACADEMY
The World's Leading Teaching and Learning Laboratory for Imagination and Inquiry

IMSAloquium:
Student Investigation Showcase
April 30, 2015

Schedule of Sessions

7:45 AM - 8:35 AM	Poster Session
8:45 AM - 9:00 AM	IMSAloquium Session 1
9:10 AM - 9:25 AM	IMSAloquium Session 2
9:35 AM - 9:50 AM	IMSAloquium Session 3
10:00 AM - 10:15 AM	IMSAloquium Session 4
10:25 AM - 10:40 AM	IMSAloquium Session 5
10:50 AM - 11:05 AM	IMSAloquium Session 6
11:15 AM - 11:30 AM	IMSAloquium Session 7
11:30 AM - 12:30 PM	Lunch
12:30 PM - 1:00 PM	Student Recognition
12:30 PM - 12:45 PM	IMSAloquium Session 8
12:55 PM - 1:10 PM	IMSAloquium Session 9
1:20 PM - 1:35 PM	IMSAloquium Session 10
1:45 PM - 2:00 PM	IMSAloquium Session 11
2:10 PM - 2:25 PM	IMSAloquium Session 12

IMSAloquium Posters and Presentations by Topic

Biochemistry

ID	Presenter	Title	Time	Room
A01	Tiffany Ding Susriya Gangireddy	The Effect of the Small Molecule Drug 54118 on the C-X-C Chemokine Receptor Type 4 in the Context of Cancer Cell Metastasis	11:15	A-135
A02	Sachin Govind	Gene Expression Analysis of Histone Modifiers in Breast Cancer	10:50	B-206 Lect. Hall
A03	Alexandra Johnson	Design of Short Peptide Amphiphile Fibers With Transition Metal Active Sites	2:10	A-119
A04	Julian Pacheco	Levels of Expression of Genes in Mice and Humans That Cause the Formation of Prostate Tumors	9:35	A-119
A05	Aishwarya Raj	Analysis of the *sypK* Gene in *Vibrio fischeri* Biofilms and Motility	8:45	A-117
A06	Taylor Reyes Nicole Tartaglia	Optimizing Expression of Cyanobacterial Light-Harvesting Complex Proteins in *Escherichia coli*	10:00	A-113

Bioengineering

ID	Presenter	Title	Time	Room
B01	Sanjay Kottapalli Alan Yang	Measuring Microbial Content of Water With Resazurin-Based Absorbance Photometry	10:50	D-110
B02	Sabrina Matthews	Improving Cancer Cell Detectability in Fluorescence Guided Brain Tumor Resection Surgery	1:45	D-110

Biology

ID	Presenter	Title	Time	Room
C01	Timothy Akintilo	Characterizing Astrocyte Morphology in Hippocampal Area CA1 in Wild Type and an Alzheimer's Disease Transgenic Mouse Model	10:25	A-119
C02	Harith Alappat	Annotating Single Nucleotide Polymorphisms to Better Define Associations for Arsenic Metabolism Observed in Genome-Wide Association Studies	9:35	A-151
C03	Waleed Ali	Meta-Analysis of mRNA Levels of Iron Metabolism Genes in Prostate Cancer	10:50	A-151
C04	Samantha Arrez Luselena Perez	The Long-Term Effect of Maternal Exposure of Ethanol in the Fruit Fly, *Drosophila melanogaster*	10:50	A-135

Biology

C05	Grace Carlberg	The Effect of Addition of a Marketed Energy Booster on the Growth Rate and Total Growth of Holstein Heifers	1:20	A-113
C06	Grace Carlberg David Kodama	The Effects of Growing Method on the Crop Efficiency in Legume Grain Crops	12:55	A-113
C07	Catherine Chen	Effects of Antibiotics on Gastrointestinal Motility and Gut Microbiota	9:10	A-117
C08	Jason Chen Angad Garg	Modeling Herpes Simplex Virus Infection to Determine Antiviral Efficacy of Zinc Oxide Nanoparticles	1:45	A-131
C09	Esther Chung	Early Oligomer Detection in Alzheimer's Disease Using Intranasal Probes	12:30	A-115
C10	Heidi Dong Sarah Xu	Investigating Nanoluciferase as a Potential Proteome Stress Sensor	9:35	D-103
C11	Chase Engelbrecht	The Effect of Omega-3 and Omega-6 Fatty Acids on the Expression of ERK and AKT in Human Pancreatic Cells	10:25	A-147
C12	Nisa Faheem Rajiv Trehan	Effects of the Micro Ribonucleic Acid miRNA-122-5p on MCF-7 Cell Proliferation	10:25	A-113
C13	Yan Lin Feng	Deoxycholic Acid Alters DNA Methylation in Caco2BBE Cells	10:25	A-117
C14	Ethan Fisher	Variations of the Cytochrome P450 Messenger RNA in *Schistosoma mansoni*	9:35	D-107
C15	Cammille Go	Halting Herpes Simplex Virus Cell-to-Cell Fusion With Zinc Oxide Nanoparticles	1:20	A-131
C16	Jonah Goughnour	Functional Response of *Toxorhynchites rutilus* to Prey Density and the Effects of Container Size	2:10	A-133
C17	Binita Gupta	Determining the Localization of *Allobaculum* Species E14 in the Mouse Intestine Using Fluorescence *in Situ* Hybridization	10:00	A-117
C18	Leehwa Hong	The Effect of Chronic, Low Levels of Phenol on the Aging of *Drosophila melanogaster*	10:00	A-135
C19	Nicholas Inocencio	The Effects of Caffeine and Taurine on Learning and Locomotion in *Drosophila melanogaster*	9:35	A-135
C20	Vivian Jin	HIV-1 Expression Profiling by High Throughput Sequencing on *in Vitro* Infected CD4+ T Cells	1:45	A-147
C21	Chinyere Kemet Stefanie Ochoa	Classification of Breast Cancer into Molecular Subtypes and the Role of Ki-67 Protein in Tumor Progression	10:25	D-107
C22	Vedhik Kodavatiganti Shveta Thakkar	I Spy: A Functional Magnetic Resonance Imaging Study of Hippocampal Activation During a Spatial Memory Task	10:25	A-115
C23	Sanjay Kottapalli	Mechanisms of WDR5- and PKN1-Driven Growth in Prostate Cancer	11:15	D-110
C24	Niresh Kuganeswaran	Genetic Comparison of Various Nitric Oxide-Adapted Cancer Cells Using *in Silico* Techniques	2:10	A-135

Biology

C25	Sarah Leahy	The Effects Food and Olfactory Enrichments Have on the Activity Time of the Grey Wolf, *Canis lupus*	8:45	A-138 Acad. Pit
C26	Monica Mastrud	Toll-Like Receptor-Induced Cytokine Production by Macrophage Cells in Response to Bacteria Exposure	9:35	A-113
C27	Samantha Medina	Anatomy and Biomechanics of the Feeding Behavior of the Alligator Gar, *Atractosteus spatula*	1:45	D-107
C28	Arthur Ortiz	Assessing Opioid-Induced Hyperalgesia in Temperature Tests With Patients Diagnosed With Chronic Low Back Pain	10:00	A-149
C29	Seong Park	Hepatic XBP-1s Regulation and Response to Deoxycholic Acid and Cholic Acid Feeding to Mice	1:45	A-149
C30	Seong Park	The Effect of Methionine-Choline Deficient Diet on Hepatic Inflammations and Liver Injuries in Phosphatidylethanolamine N-Methyltransferase Deficient Mice	11:15	A-151
C31	Kyle Parker	Distribution of Mutated Yet Functional Pro-Apoptotic Protein BaxΔ2 in Human Organs and Tissues	8:45	A-151
C32	Mit Patel	Investigating the Impact of Bacteria on Gene Expression in Germ-Free and Specific-Pathogen-Free Enteroids and Colonoids	10:50	A-117
C33	Samuel Qian	Exploration of Acetyl-CoA Carboxylase to Develop Fungicides for Agriculture	11:15	D-103
C34	Naren Radhakrishnan	Identifying Candidate Genes and Pathways in Autism	8:45	D-107
C35	Maureen Reiser	Comparative Analysis of Vaccination Reactions in Dogs	9:35	A-133
C36	Megan Smiley	The Effects of Deleting Foxo1 in the Pituitary of Mice at Embryonic Day 14.5	1:20	A-149
C37	Ranjani Sundar	Modeling the Interaction Between Insulin and Insulin-Degrading Enzyme: A Molecular Dynamics Simulation Study	11:15	A-119
C38	Shelly Teng	The Effects of A4VSOD1 Mutant Protein Incorporation on Calcium Ion Membrane Conductance	11:15	A-113
C39	Andy Xu	The Effect of Parental Age on Mental Capabilities in Children	12:30	A-119
C40	Andy Xu	The Effect of Endothelin-1 on Canine Atrial Myocytes	1:20	A-119
C41	Huiran Zhang	Determination of the Optimal Method of Transformation for MCF-10A Cells	10:50	A-155
C42	Mickinney Zhang	The Mechanisms to Break the Vertebrate Ground Plan by Shifts of *Hox* Code in Skates, *Leucoraja erinacea*	1:20	A-147

Business

ID	Presenter	Title	Time	Room
D01	Calvin Zhu	The Effect of Public Announcements on a Cell Phone Manufacturer's Performance in the Stock Market	12:55	D-110

Chemistry

ID	Presenter	Title	Time	Room
E01	Kyle Chen	Characteristics of Polymer Modification Using the Sequential Infiltration Synthesis Process Under High Pressure	9:35	A-147
E02	Maya Costales	Characteristics of Developed Polymethyl Methacrylate in Mixtures of Alcohol and Water	8:45	A-147
E03	Ryan Franks	Reducing Background Adsorption by Condensing Ethylene Glycol on Silica With Grafted Calixarenes	1:45	A-113
E04	Ryan Franks	The Effect of Surface Treatments on Metal Catalysts for the Epoxidation of Cyclohexene	2:10	A-113
E05	Ashu Gupta	Fabrication of a Methane Sensor by Zinc Oxide Functionalization of Multi-Walled Carbon Nanotubes	11:15	A-149
E06	Nicholas Inocencio	Conjugation of Open Cage Decaborane Clusters to 1,3,4-Thiadiazole Using Propargyl Bromide	9:10	A-135
E07	Devdhi Kasana	Study of Hydrophilicity of Titanium Dioxide Thin Film Deposition on SnO_x by Water Contact Angle Measurements	8:45	A-133
E08	Jaida Lewis Bria Williamson	The Effect of Benzoyl Peroxide and Salicylic Acid on MCF-7 Epithelial Cells	2:10	A-121
E09	Liam McParland Luke Morrical	A Study of the Properties of Films for Use in Organic Light Emitting Diodes	10:50	A-113
E10	Sarah Mou	Determination of Surface Free Energy and Wettability of Atomic Layer Deposited CeO_2, ZrO_2, HfO_2, and Er_2O_3	9:10	A-133
E11	Joy Qiu	Electroanalytical Determination of Propranolol Using Flow Injection Analysis With Amperometric Detection	8:45	A-119
E12	Vivek Vermani	Understanding the Drainage of Foam	10:00	B-206 Lect. Hall
E13	Aspen Wheeler	Structure and Activity of Sulfur-Based Radicals in Small Biological Compounds	12:55	B-206 Lect. Hall

Computer Science

ID	Presenter	Title	Time	Room
F01	Jorge Adorno	Innate Learning: Understanding Binocular Visual Development Through Efficient Coding	1:45	A-117
F02	Arun Arjunakani	Using WProf to Analyze Page Loading Time in Webpages	2:10	A-117

Computer Science

F03	Arun Arjunakani	A Cloud-Based Front End for Real-Time Activity Recognition From Wearable Sensor Data	12:55	A-147
F04	Rakesh Chatrath Tiger Shi	Investigations on and Repairs to Issues With the Current Residential Checking System at IMSA	11:15	A-138 Acad. Pit
F05	Daniel Costa	Downed Aircraft: A Search and Rescue Flight Path Interpolation Tool	12:30	E-115 Kids Inst.
F06	Matthew Dyas	Acceleration and Rapid Prototyping of Real-Time Computer Vision Applications Written in Python	9:10	A-155
F07	Sachin Govind	Minimal Probing Algorithms for Membership Queries on Large Sets	1:45	A-151
F08	Kushagra Gupta Noor Michael	Designing Artificial Intelligence Algorithms That Outperform Humans in Simulated Real-World Scenarios	12:55	A-133
F09	Gene Kim	Designing an Augmented Reality Particle Detector to Teach Fermilab Visitors About Neutrinos	9:10	D-107
F10	Arun Kumar	The Combinations and Modifications of Delays	11:15	D-107
F11	Angela Lee Isabella Lee	Performance Comparison of the Transmission Control Protocol and User Datagram Protocol in Supporting a Video Streaming System Programmed Using Java	1:20	A-133
F12	Vishal Patel Ray Sun	The Singularity: What is it, Where Will it Come From, and How do You Survive?	2:10	B-206 Lect. Hall
F13	Kody Puebla	Extending Java to Include Traits for Method Reuse	2:10	A-131
F14	Lydia Stone*	An Algorithm to Find the Height of a Multihop Wireless Network's Strip Yielding Maximum Efficiency	*	*
F15	Yash Thacker	Designing a Novel Algorithm to Analyze Organelles in the Cell	9:35	B-206 Lect. Hall
F16	Jacqueline Vega	Software Rejuvenation in Cloud Computing	2:10	A-147

Economics

ID	Presenter	Title	Time	Room
G01	Timothy Gietl	Statistical Arbitrage and Execution in Exchange-Traded Fund Markets	12:55	A-121
G02	Huajie Huang	Algorithm for Market Dynamics in the Trade-At-Settlement Futures Markets	10:50	A-121
G03	Camden Ko	Extracting Zero Rates and Discount Factors From Treasury Bonds	1:20	A-121
G04	Vivian Liu	Effects of Weather Forecasts on the Planting Decisions of Farmers	1:45	D-103

Economics

G05	Daniel Pechi	The Effect of Competitive Natural Gas Prices on Air Quality and Public Health in the United States	1:45	E-115 Kids Inst.
G06	Joy Qiu	Optimizing Delta Hedging for the Trading of U.S. Treasuries Options and Futures	9:10	A-119
G07	David Xu	Existence of Post-Earnings Announcement Drift in Brazilian Financial Markets	11:15	A-121

Education

ID	Presenter	Title	Time	Room
H01	Puja Mittal	Creating the Customer Archetype for English e-Learning in India	2:10	A-149

Engineering

ID	Presenter	Title	Time	Room
I01	Kevin Chen	Investigation of Potential Benefits of Unmanned Aerial Vehicles	2:10	E-115 Kids Inst.
I02	Tyler Cluff Roopa Rajesh	Developing a Mission Communication System for High Altitude Balloons	9:10	A-131
I03	Drake Eidukas	Thermodynamic Analysis of the Heusler Alloy Nickel-Manganese-Tin	10:50	A-147
I04	Erik Seungwoo Nam	The Elastic Properties of Silicon Functionalized Graphene Nano-Platelet Reinforced Potassium Geopolymer by the Impulse Excitation	10:25	B-206 Lect. Hall
I05	Eleanor Naudzius	Evaluation of the Efficiency of Contemporary Contact Precautions and the Development of a New Barrier Precaution Prototype	1:20	D-103
I06	Paul Nebres	Designing a System for the Magnet Shimming Trials of the Muon g-2 Experiment	10:00	A-131
I07	Sean Potempa Grant Williams	Providing Power for an Ultraviolet Light Water Purifier for the Developing World	1:20	D-110
I08	Sattvic Ray	Designing a DC-DC Converter for the Mu2e T-Tracker	12:30	B-206 Lect. Hall
I09	Mylee Rolock	Development of Open Source Ultrasonic, Dust, and Solar Panel Sensors	10:50	A-149
I10	Adit Suvarna	A Multiplexed Readout Scheme for a Large Array of Photomultiplier Tubes	10:00	A-155
I11	Nikhilesh Thota Franklin Ye	Design and Construction of a Water Purification System Utilizing Ultraviolet Light	2:10	D-107

Engineering

I12	John Valin	Effect of Double Aging and Room Temperature Aging on Properties and Stress Corrosion Cracking of the Aluminum Alloy AA7075	11:15	A-147
I13	Thomas Wan	Composition Analysis of Solid Oxides Deposited Through Atomic Layer Deposition	1:20	A-151

English

ID	Presenter	Title	Time	Room
J01	Ana Curtis	This is the End: Gendered Closure in Victorian Literature, 1840-1859	2:10	A-138 Acad. Pit
J02	Manojna Namuduri	Evolution of Feminine Archetypes in Russia From Folklore to the Literature of the Twentieth Century	10:00	D-110

Environmental Science

ID	Presenter	Title	Time	Room
K01	Katherine Su	A Chemical Equilibrium Analysis of Mercury Adsorption Onto *Escherichia coli* Surfaces	12:55	A-151

History

ID	Presenter	Title	Time	Room
L01	Jamie Candler	Roles of Women Worldwide in World War II	2:10	D-110
L02	Fiona Kurylowicz Emily Schuster	Racial and Ethnic Relations in America During World War II	10:00	E-115 Kids Inst.
L03	Cristal Quinones	An Examination of the Source of the Instability of the Mexican Government After Independence From Spain	1:45	B-206 Lect. Hall
L04	Ziang Wang	Economic Implications of Chinese Presence in Africa: Foreign Aid, Migration, and Resource Extraction	1:20	A-135

Law

ID	Presenter	Title	Time	Room
M01	Joseph Longo	The Challenges of Apprehending Identity Thieves: Methods and Techniques That Police Officers Can Use to Investigate Identity Theft	1:20	D-107

Mathematics

ID	Presenter	Title	Time	Room
N01	Emily Jia	Unitary Braid Representations of B(3) to SU(2)	9:10	D-103
N02	Alan Liang	The Erdos-Hajnal Conjecture: Case for T-Monotone Curves	9:35	D-110

Mathematics

N03	Christopher Rogers Mark Rogers	Examining Different Factors That Help Predict a National Basketball Association Player's Future Monetary Value	10:00	A-138 Acad. Pit
N04	Aquila Ryu Brice Wang	Analyzing an Entailed Variant of the Impartial Game Nim	8:45	A-155
N05	Jason Yang	The Understanding and Analysis of the A5/1 Stream Cipher Utilized in Security of Everyday Cell Phones	8:45	D-110

Medicine

ID	Presenter	Title	Time	Room
O01	Max Ackerman	Endoscopic and Histologic Disease Activity are Associated With Risk of Hospitalization and Colectomy in Patients With Ulcerative Colitis	9:35	A-155
O02	Edward Carson	Sepsis-Associated Modulation of Pentraxin and Other Inflammatory Mediators	10:00	A-121
O03	Sarah Dovgin	Using Peptide Phosphorodiamidate Morpholino Oligomers to Inhibit Phosphoglycerate Mutase Within Tachyzoites of *Toxoplasma gondii*	8:45	A-149
O04	Sarah Dovgin	Analysis and Inhibition of Ornithine Aminotransferase Within *Toxoplasma gondii* Oocysts, Tachyzoites, and Bradyzoites	9:10	A-149
O05	Lohitha Guntupalli	The Association Between a Single Nucleotide Polymorphism of the CALC 1 Gene and Malaria in the South Indian Population	11:15	B-206 Lect. Hall
O06	Lija Hoffman	Effects of Exercise and Manual Therapy on Weight Loss and Lower Extremity Functional Mobility	10:25	A-135
O07	Fengling Hu	Mechanisms of Host-Viral Interactions in the Gut Leading to Loss of Oral Tolerance: A Prerequisite in Celiac Disease Pathogenesis	10:25	D-103
O08	Divya Jasthi Faith Leslie Hope Leslie	The Correlation Between Neonatal Disease Severity and the ABO Blood Group	10:25	A-149
O09	Omair Khan	Burn Injury Alters the Intestinal Microbiome and Increases Gut Permeability and Bacterial Translocation	1:45	A-119
O10	August Nagro	Aberrant TGFβ Responses in Post Epithelial-Mesenchymal Transition Cancer Cells	10:00	A-147
O11	Eleanor Naudzius	Bacterial Coinfection and Antimicrobial Resistance in Patients With Viral Community-Acquired Pneumonia	12:55	D-103
O12	Keelyn O'Brien	Analysis of the Immune Response to Methicillin Resistant *Staphylococcus aureus* Surface Proteins FnBPA, ClfA, SdrE, and SdrD for Vaccine Development	1:20	B-206 Lect. Hall
O13	Aadit Shah	Glioblastoma Induces Immunosuppression via Regulatory T cells, PDL1, and CTLA4	8:45	A-121

Medicine

O14	Mitchell Sun	Toxicity of Oxaliplatin Resulting in Peripheral Sensory Neuropathy Detected Through Nerve Conduction Studies and Needle Electromyography	11:15	A-117

Neurobiology

ID	Presenter	Title	Time	Room
P01	Jyotsna Bitra Jessica Phung	Use of a Novel Magnetic Resonance Imaging Compatible Head-Positioning Device for Three-Dimensional Kinematic Analysis of the Cervical Spine in Axial Rotation	10:50	A-115
P02	Lauren Bystrom Hanna Flatness	Gray Matter Volumes in Glioblastoma Multiforme Patients Using Structural Imaging	10:25	A-133
P03	Kristin Carlson	Altered Brain Activity Between Language Tasks Project How Individuals in a Minimal Conscious State Process Language	1:20	A-115
P04	Greeshma Chilukuri Sameeksha Malhotra	Involvement of mGluR5 and MOR Heterodimers as Novel Targets to Treat Alzheimer's Disease	9:35	A-115
P05	Gloria Choi Kirstin Johnson	Effect of Varying Musical Stimuli on Memory Recall	10:25	A-151
P06	Nicholas Damen	Differentiation of Angiomatous and Non-Angiomatous Meningiomas Using High b-Value Diffusion Imaging With a Fractional Order Calculus Model	1:45	A-121
P07	Grace Duan	Automatic Lesion Segmentation: Applying Mean Shift Clustering and Brain Symmetry	8:45	A-115
P08	Grace Duan Sameeksha Malhotra	Active Brain Regions During Sleep Using Electroencephalography-Functional Magnetic Resonance Imaging	9:10	A-115
P09	Sarah Eaton	Determining Offset Analgesia With Dual Stimuli Applied to Opposite, Proximal, and Distal Locations	10:50	D-107
P10	Nathan Errampalli Michael Qian	Amyloid Precursor Protein and Amyloid-β Oligomer Concentrations are Connected in Developing Chicken Embryos	1:45	A-115
P11	Zeidy Garcia	The Effects of Functional Electrical Stimulation on Hand Control	1:20	E-115 Kids Inst.
P12	Rajangad Gurtatta	Effects of Acute Ethanol Exposure on the Expression of the Gamma Amino Butyric Acid Receptor Subunits in Rat Cortex	2:10	A-151
P13	Cindy Ho	Role of Oligodendrocytes in Ischemic Brain Repair	12:30	A-135

Neurobiology

P14	Kirstin Johnson	Eye Tracking, Pulmonary Tracking, and Heart Rate Tracking Using Various Stimuli	8:45	B-206 Lect. Hall
P15	Abrar Khaja	Investigating the Functional Properties of PD-L1 in Mice Glioblastoma Multiforme	9:10	A-121
P16	Joshua Kleinman	The Effect of Antipsychotic Risperidone Treatment on Neuroanatomical Volumetric Deformations in Rats	10:00	A-133
P17	Neal Modi Tian Lin Yuan	Using Functional Connectivity in the Basal Ganglia as a Biomarker for Parkinson's Disease	10:00	A-115
P18	Naima Muckom	Examining the Specificity of N-Methyl-D-Aspartate 2B Receptor Targeted Primary Antibodies Using Fluorescent Microscopy	12:30	D-107
P19	Charmaine Ong	The Effects of Menadione on Cancer Cell Metabolism and Mitochondrial Health	10:00	D-103
P20	Khusbu Patel	Changes in Resting State Functional Connectivity in the Default Mode Network From Chemotherapy-Induced Cognitive Impairment in Breast Cancer Patients	10:50	A-133
P21	Ahsan Qureshi	The Impact of Traumatic Brain Injury on the Morphology of Mouse Astrocytes	10:50	A-119
P22	Malavika Ramnath	Statistical Differences in the Resting State Network of Iraqi Veterans and Former National Football League Players	11:15	A-115
P23	Rashmi Thimmapuram	An Electrocorticographic Study of Cerebral Activation During Moral Judgments	9:35	A-121
P24	Jason Wu	Correlation of Memory Dysfunction and Aβ Build-Up in an Alzheimer's Disease Transgenic Mouse Model	12:55	A-115

Physics

ID	Presenter	Title	Time	Room
Q01	Niharika Agrawal	Quantifying the Effects of the Ionization Detector on the g-2 Magnet's Magnetic Field	9:35	A-131
Q02	Vikram Anjur	The Effect of Shear to Bulk Modulus Ratio on the Crumpling of a Sheet	1:45	A-135
Q03	Mobolaji Bankole	Causes of Cosmic Muon Detection Rate Loss in the MINOS Particle Detector Experiment	12:30	A-131
Q04	Varun Iyer	Supernovae Neutrino Interaction Modeling Through Neutrino Event Generation	9:10	A-151
Q05	Violet Konopka	Determining the Performance of Muon Ionization Detectors With Different Thresholds and Straw Diameters Based on Time and Spatial Resolution	11:15	A-155
Q06	Monica Mastrud	Effect of Surface Characteristics of Lead Glass on the Ability to Collect Light in Calorimeters	9:10	A-113
Q07	Nicholas Michuda	Discovering the Viability of Versa Module Europa Boards as Time-to-Digital Converters Through Root	8:45	D-103

Physics

Q08	Dawson Patel	The Search for Standard Model Higgs Events in Associated WH Production Resulting in the b Anti-b Decay Channel With DØ Data	12:55	E-115 Kids Inst.
Q09	Ashrita Raghuram	Discerning Cosmic Rays From Neutrino Beam Events in the NOvA Experiment	11:15	A-131
Q10	Alan Ren	Scanning Neutrino Events and Experimental Data: Monte Carlo Comparisons for Proton Scattering With Iron, Carbon, and Nickel	10:50	E-115 Kids Inst.
Q11	Dennis Rich	Free Energy Landscapes of Self-Drying Pores	12:30	A-149
Q12	Daniel Sohn	Using Root to Visualize the Performance of Ionization Characters	10:25	A-131
Q13	Alan Yang	Investigating Electrical Breakdown in High Voltage Feedthroughs in Liquid Argon	10:25	D-110
Q14	Timothy Zhou	Heavy Flavor Content in Events With a Z Boson and Two Jets	12:30	D-103

Psychology

ID	Presenter	Title	Time	Room
R01	Marissa Brock Claire Lee	Measuring Effective Methods of Stress Reduction for Students in Academically Rigorous Environments	9:10	A-138 Acad. Pit
R02	Alice Gong Crystal Gong	The Effects of Social Exclusion on Emotion Intelligence and Perceived Likeability	11:15	E-115 Kids Inst.
R03	Faithe Hill	Inhibitory Control as a Predictor of Drug Reward Following Amphetamine, Ethanol, and Tetrahydrocannabinol	1:20	A-117
R04	Kevin Hinterlong	The Variability in Heart Rates of Officers During Workdays Due to the Severity of Weather, Traffic, and the Situation	12:55	D-107
R05	Daniel Holley	The Neuropsychological Impacts of Suicidal Ideation of Urban Homeless Youth	1:45	A-138 Acad. Pit
R06	Ashley Kerley Livia Way	How Self-Perception of Work Ethic Differs From Observer Perception in IMSA Students	9:35	E-115 Kids Inst.
R07	Kaitlyn Schmieder	The Effects of Depression on Memory in Dementia Patients	10:25	E-115 Kids Inst.
R08	Aniruddha Shekara	The Effects of State and Trait Anxiety on Subjective Effects of Alcohol Use	12:55	A-117
R09	Kyle Thomas	Observing the Extent of the Implicit Associations Within the IMSA Community	9:10	E-115 Kids Inst.

Social Science

ID	Presenter	Title	Time	Room
S01	Amber Acquaye	Factors That Mediate HIV Sexual Risk Behaviors in Academically Talented African American Youth	9:35	A-138 Acad. Pit
S02	Susriya Gangireddy	Possible Racial and Ethnic Segregation on Social Media With Multi-Color Populations	10:25	A-138 Acad. Pit
S03	Cameron Hudgins	Does Student Dress Affect Teacher Grading?	10:50	A-138 Acad. Pit
S04	Nicholas Kiene Vivian Liu	Cinematocracy: Social and Political Anxieties About Russia in Film	2:10	D-103
S05	Trennedy Kleczewski	The Understanding of African American Females' Journeys in Pursuit of a Career in the STEM Fields	1:20	A-138 Acad. Pit

Space Science

ID	Presenter	Title	Time	Room
T01	William Drennan	Simulating the Movement and Fragmentation of a Meteor Descending Through the Atmosphere	8:45	A-131
T02	Arianna Osar	Mapping Red Clump Stars in North and South Galactic Caps	9:10	B-206 Lect. Hall
T03	Erich Remiker Vinay Sama	Designing Life Support Systems on a Space Settlement	12:30	D-110
T04	Anabel Rivera	Using a Galactic Model to Search for Red Clump Stars in the Sagittarius Stream	1:45	A-133

* Lydia Stone is attending the Junior Sciences and Humanities Symposium National Conference and will present at an alternate time.

Poster Map

Cafeteria

A01		B01	C05	C11	C17	C23	
A02		B02	C06	C12	C18	C24	
A03		C01	C07	C13	C19	C25	
A04		C02	C08	C14	C20	C26	
A05		C03	C09	C15	C21	C27	
A06		C04	C10	C16	C22	C28	

C29	C30	C31	C32	C33	C34	C35	C36	C37	C38	C39	C40	C41	C42
D01	E01	E02	E03	E04	E05	E06	E07	E08	E09	E10	E11	E12	E13

F01	F02	F03	F04	F05	F06	F07	F08	F09	F10	F11	F12	F13	F14	F15	F16	G01	G02
G03	G04	G05	G06	G07	H01	I01	I02	I03	I04	I05	I06	I07	I08	I09	I10	I11	I12

L01	L02	L03	L04	M01	N01	N02	N03	N04	N05	O01	O02	O03	O04	O05	O06

I13	
J01	
J02	
K01	

O07	O08

O09
O10

Old Cafeteria/Commons

Diagram Not to Scale

* Biochemistry: A01-A06
* Bioengineering: B01-B02
* Biology: C01-C42
* Business: D01
* Chemistry: E01-E13
* Computer Science: F01-F16
* Economics: G01-G07
* Education: H01
* Engineering: I01-I13
* English: J01-J02
* Environmental Science: K01
* History: L01-L04
* Law: M01
* Mathematics: N01-N05
* Medicine: O01-O10

continued

Old Cafeteria/Commons

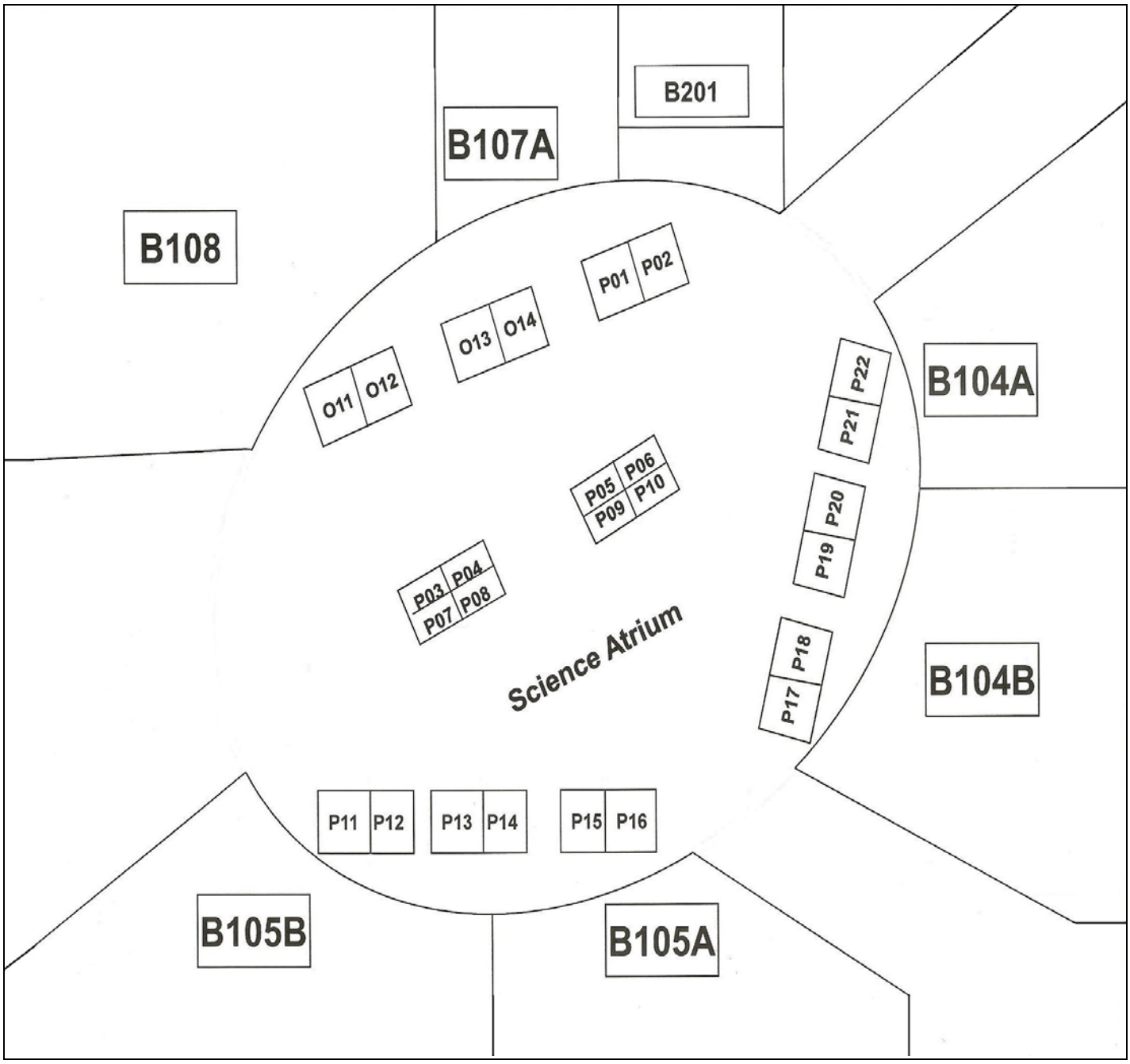


Diagram not to Scale

* Medicine Continued: O11-O14
* Neurobiology: P01-P22

continued

Poster Map

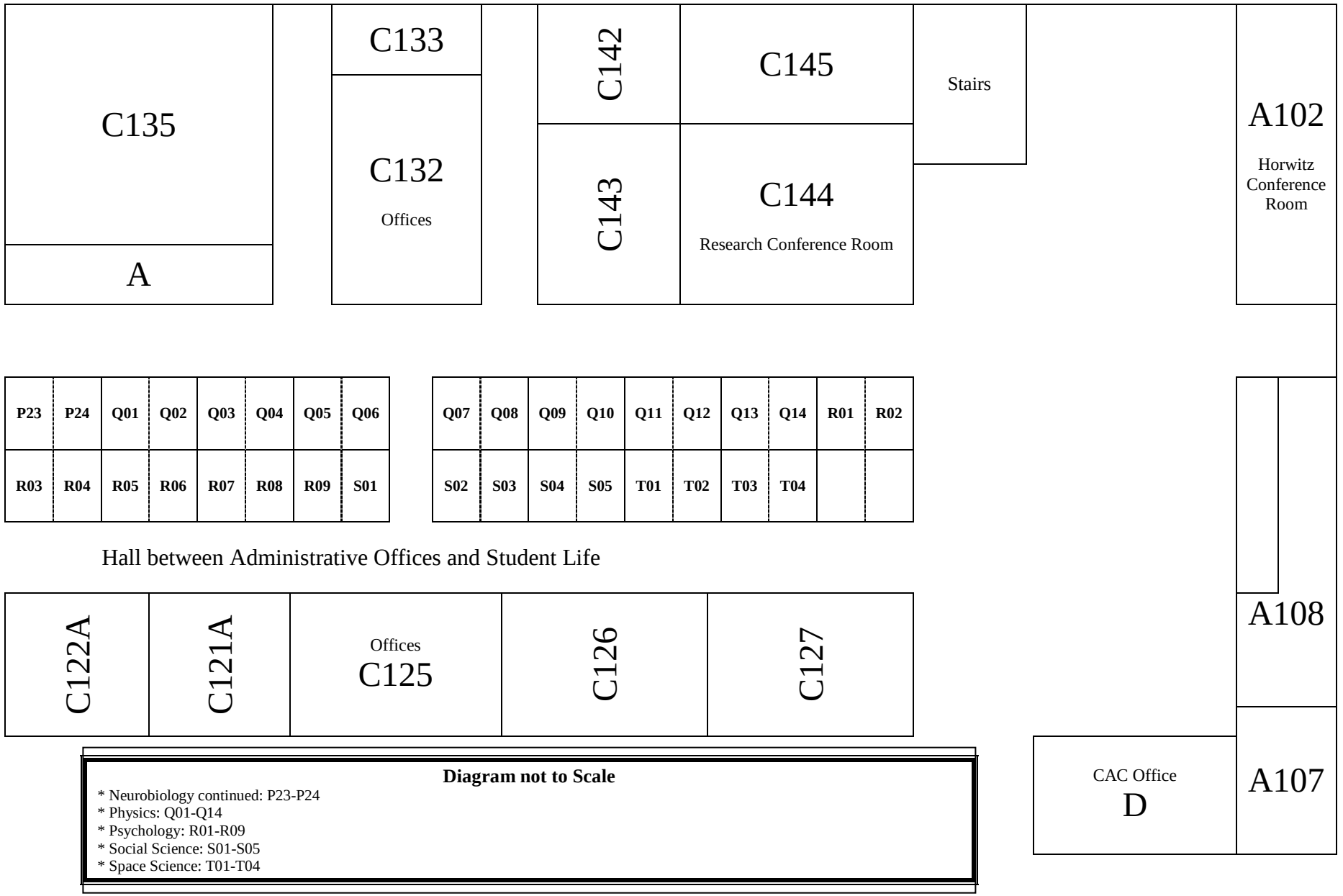


Diagram not to Scale

* Neurobiology continued: P23-P24
* Physics: Q01-Q14
* Psychology: R01-R09
* Social Science: S01-S05
* Space Science: T01-T04

Time and Room Schedule for Presentations

8:45 - 9:00

Room	ID	
A-115	P07	**Automatic Lesion Segmentation: Applying Mean Shift Clustering and Brain Symmetry** Grace Duan; Advisor(s): Todd Parrish, Bao Wang, Xue Wang
A-117	A05	**Analysis of the *sypK* Gene in *Vibrio fischeri* Biofilms and Motility** Aishwarya Raj; Advisor(s): Cecilia M. Thompson, Karen L. Visick
A-119	E11	**Electroanalytical Determination of Propranolol Using Flow Injection Analysis With Amperometric Detection** Joy Qiu; Advisor(s): D'Nisha Hamblin, Greg Swain
A-121	O13	**Glioblastoma Induces Immunosuppression via Regulatory T cells, PDL1, and CTLA4** Aadit Shah; Advisor(s): Leonel Ampie, Winward Choy, Shayan Fakurnejad, Andrew Parsa
A-131	T01	**Simulating the Movement and Fragmentation of a Meteor Descending Through the Atmosphere** William Drennan; Advisor(s): Mark Hammergren, Lou Nigra, Ken Walczak
A-133	E07	**Study of Hydrophilicity of Titanium Dioxide Thin Film Deposition on SnO_x by Water Contact Angle Measurements** Devdhi Kasana; Advisor(s): Christos Takoudis
A-138 Acad. Pit	C25	**The Effects Food and Olfactory Enrichments Have on the Activity Time of the Grey Wolf, *Canis lupus*** Sarah Leahy; Advisor(s): C. Robyn Fischer, Randy Johnson
A-147	E02	**Characteristics of Developed Polymethyl Methacrylate in Mixtures of Alcohol and Water** Maya Costales; Advisor(s): Leonidas Ocola
A-149	O03	**Using Peptide Phosphorodiamidate Morpholino Oligomers to Inhibit Phosphoglycerate Mutase Within Tachyzoites of *Toxoplasma gondii*** Sarah Dovgin; Advisor(s): Kamal El-Bissati, Joseph Lykins, Rima McLeod, Kelsey Wheeler, Ying Zhou
A-151	C31	**Distribution of Mutated Yet Functional Pro-Apoptotic Protein BaxΔ2 in Human Organs and Tissues** Kyle Parker; Advisor(s): Adriana Mañas, Jialing Xiang
A-155	N04	**Analyzing an Entailed Variant of the Impartial Game Nim** Aquila Ryu, Brice Wang; Advisor(s): Micah Fogel
B-206 Lect. Hall	P14	**Eye Tracking, Pulmonary Tracking, and Heart Rate Tracking Using Various Stimuli** Kirstin Johnson; Advisor(s): Moran Cerf
D-103	Q07	**Discovering the Viability of Versa Module Europa Boards as Time-to-Digital Converters Through Root** Nicholas Michuda; Advisor(s): Jin-Yuan Wu

8:45 - 9:00

Room	ID	
D-107	C34	**Identifying Candidate Genes and Pathways in Autism** Naren Radhakrishnan; Advisor(s): Martin Forde
D-110	N05	**The Understanding and Analysis of the A5/1 Stream Cipher Utilized in Security of Everyday Cell Phones** Jason Yang; Advisor(s): Byol Kim, Lek-Heng Lim

9:10 - 9:25

Room	ID	
A-113	Q06	**Effect of Surface Characteristics of Lead Glass on the Ability to Collect Light in Calorimeters** Monica Mastrud; Advisor(s): Corrado Gatto, Anna Mazzacane
A-115	P08	**Active Brain Regions During Sleep Using Electroencephalography-Functional Magnetic Resonance Imaging** Grace Duan, Sameeksha Malhotra; Advisor(s): Todd Parrish
A-117	C07	**Effects of Antibiotics on Gastrointestinal Motility and Gut Microbiota** Catherine Chen; Advisor(s): Eugene Chang, Ketrija Touw
A-119	G06	**Optimizing Delta Hedging for the Trading of U.S. Treasuries Options and Futures** Joy Qiu; Advisor(s): Faris Hitti
A-121	P15	**Investigating the Functional Properties of PD-L1 in Mice Glioblastoma Multiforme** Abrar Khaja; Advisor(s): Shayan Fakurneja, Rajwant Kaur, Andrew Parsa
A-131	I02	**Developing a Mission Communication System for High Altitude Balloons** Tyler Cluff, Roopa Rajesh; Advisor(s): Lou Nigra, Ken Walczak
A-133	E10	**Determination of Surface Free Energy and Wettability of Atomic Layer Deposited CeO_2, ZrO_2, HfO_2, and Er_2O_3** Sarah Mou; Advisor(s): Arghya Bishal, Christos Takoudis
A-135	E06	**Conjugation of Open Cage Decaborane Clusters to 1,3,4-Thiadiazole Using Propargyl Bromide** Nicholas Inocencio; Advisor(s): Narayan Hosmane
A-138 Acad. Pit	R01	**Measuring Effective Methods of Stress Reduction for Students in Academically Rigorous Environments** Marissa Brock, Claire Lee; Advisor(s): William Gentzler, David Lundgren, Jay Thomas
A-149	O04	**Analysis and Inhibition of Ornithine Aminotransferase Within *Toxoplasma gondii* Oocysts, Tachyzoites, and Bradyzoites** Sarah Dovgin; Advisor(s): Kamal El-Bissati, Joseph Lykins, Rima McLeod, Kelsey Wheeler, Ying Zhou
A-151	Q04	**Supernovae Neutrino Interaction Modeling Through Neutrino Event Generation** Varun Iyer; Advisor(s): Gabriel Perdue

9:10 - 9:25

Room	ID	
A-155	F06	**Acceleration and Rapid Prototyping of Real-Time Computer Vision Applications Written in Python** Matthew Dyas; Advisor(s): Brian Donahoe
B-206 Lect. Hall	T02	**Mapping Red Clump Stars in North and South Galactic Caps** Arianna Osar; Advisor(s): James Annis
D-103	N01	**Unitary Braid Representations of B(3) to SU(2)** Emily Jia; Advisor(s): John Boller, Niels Nygaard
D-107	F09	**Designing an Augmented Reality Particle Detector to Teach Fermilab Visitors About Neutrinos** Gene Kim; Advisor(s): Benjamin Carls
E-115 Kids Inst.	R09	**Observing the Extent of the Implicit Associations Within the IMSA Community** Kyle Thomas; Advisor(s): Adrienne Coleman

9:35 - 9:50

Room	ID	
A-113	C26	**Toll-Like Receptor-Induced Cytokine Production by Macrophage Cells in Response to Bacteria Exposure** Monica Mastrud; Advisor(s): C. Robyn Fischer
A-115	P04	**Involvement of mGluR5 and MOR Heterodimers as Novel Targets to Treat Alzheimer's Disease** Greeshma Chilukuri, Sameeksha Malhotra; Advisor(s): William Klein, Kirsten Viola
A-119	A04	**Levels of Expression of Genes in Mice and Humans That Cause the Formation of Prostate Tumors** Julian Pacheco; Advisor(s): Hannah Brechka, Donald Vander Griend, Anthony Williams
A-121	P23	**An Electrocorticographic Study of Cerebral Activation During Moral Judgments** Rashmi Thimmapuram; Advisor(s): Vernon Leo Towle
A-131	Q01	**Quantifying the Effects of the Ionization Detector on the g-2 Magnet's Magnetic Field** Niharika Agrawal; Advisor(s): Brendan Kiburg, Mandy Rominsky
A-133	C35	**Comparative Analysis of Vaccination Reactions in Dogs** Maureen Reiser; Advisor(s): Helen Dane, Sarah Johnson
A-135	C19	**The Effects of Caffeine and Taurine on Learning and Locomotion in *Drosophila melanogaster*** Nicholas Inocencio; Advisor(s): Vandana Chinwalla
A-138 Acad. Pit	S01	**Factors That Mediate HIV Sexual Risk Behaviors in Academically Talented African American Youth** Amber Acquaye; Advisor(s): Camesha Jones, Dexter Voisin

9:35 - 9:50

Room	ID	
A-147	E01	**Characteristics of Polymer Modification Using the Sequential Infiltration Synthesis Process Under High Pressure** Kyle Chen; Advisor(s): Leonidas Ocola
A-151	C02	**Annotating Single Nucleotide Polymorphisms to Better Define Associations for Arsenic Metabolism Observed in Genome-Wide Association Studies** Harith Alappat; Advisor(s): Brandon Pierce
A-155	O01	**Endoscopic and Histologic Disease Activity are Associated With Risk of Hospitalization and Colectomy in Patients With Ulcerative Colitis** Max Ackerman; Advisor(s): Ruben Colman, Sarah Goeppinger, David Rubin
B-206 Lect. Hall	F15	**Designing a Novel Algorithm to Analyze Organelles in the Cell** Yash Thacker; Advisor(s): Yang Li, Jane Wu
D-103	C10	**Investigating Nanoluciferase as a Potential Proteome Stress Sensor** Heidi Dong, Sarah Xu; Advisor(s): Sue Fox, Richard Morimoto, Anan Yu
D-107	C14	**Variations of the Cytochrome P450 Messenger RNA in *Schistosoma mansoni*** Ethan Fisher; Advisor(s): David Williams, Peter Ziniel
D-110	N02	**The Erdos-Hajnal Conjecture: Case for T-Monotone Curves** Alan Liang; Advisor(s): Andrew Suk
E-115 Kids Inst.	R06	**How Self-Perception of Work Ethic Differs From Observer Perception in IMSA Students** Ashley Kerley, Livia Way; Advisor(s): David Evenson

10:00 - 10:15

Room	ID	
A-113	A06	**Optimizing Expression of Cyanobacterial Light-Harvesting Complex Proteins in *Escherichia coli*** Taylor Reyes, Nicole Tartaglia; Advisor(s): C. Robyn Fischer
A-115	P17	**Using Functional Connectivity in the Basal Ganglia as a Biomarker for Parkinson's Disease** Neal Modi, Tian Lin Yuan; Advisor(s): Todd Parrish
A-117	C17	**Determining the Localization of *Allobaculum* Species E14 in the Mouse Intestine Using Fluorescence *in Situ* Hybridization** Binita Gupta; Advisor(s): Eugene Chang, Daina Ringus
A-121	O02	**Sepsis-Associated Modulation of Pentraxin and Other Inflammatory Mediators** Edward Carson; Advisor(s): Jawed Fareed, Debra Hoppensteadt-Moorman, Michael Mosier, Amanda Walborn
A-131	I06	**Designing a System for the Magnet Shimming Trials of the Muon g-2 Experiment** Paul Nebres; Advisor(s): Brendan Kiburg

10:00 - 10:15

Room	ID	
A-133	P16	**The Effect of Antipsychotic Risperidone Treatment on Neuroanatomical Volumetric Deformations in Rats** Joshua Kleinman; Advisor(s): Kate Blizinsky, Ashley Walters, Lei Wang
A-135	C18	**The Effect of Chronic, Low Levels of Phenol on the Aging of *Drosophila melanogaster*** Leehwa Hong; Advisor(s): Vandana Chinwalla
A-138 Acad. Pit	N03	**Examining Different Factors That Help Predict a National Basketball Association Player's Future Monetary Value** Christopher Rogers, Mark Rogers; Advisor(s): Mary Myers
A-147	O10	**Aberrant TGFβ Responses in Post Epithelial-Mesenchymal Transition Cancer Cells** August Nagro; Advisor(s): Paul Grippo
A-149	C28	**Assessing Opioid-Induced Hyperalgesia in Temperature Tests With Patients Diagnosed With Chronic Low Back Pain** Arthur Ortiz; Advisor(s): Sara Connolly, R. Norman Harden, Alexandre Khoury, Amy Kirsling
A-155	I10	**A Multiplexed Readout Scheme for a Large Array of Photomultiplier Tubes** Adit Suvarna; Advisor(s): Jin-Yuan Wu
B-206 Lect. Hall	E12	**Understanding the Drainage of Foam** Vivek Vermani; Advisor(s): Vivek Sharma
D-103	P19	**The Effects of Menadione on Cancer Cell Metabolism and Mitochondrial Health** Charmaine Ong; Advisor(s): David Braun, Douglas Feinstein
D-110	J02	**Evolution of Feminine Archetypes in Russia From Folklore to the Literature of the Twentieth Century** Manojna Namuduri; Advisor(s): Daniel Gleason
E-115 Kids Inst.	L02	**Racial and Ethnic Relations in America During World War II** Fiona Kurylowicz, Emily Schuster; Advisor(s): Claiborne Skinner

10:25 - 10:40

Room	ID	
A-113	C12	**Effects of the Micro Ribonucleic Acid miRNA-122-5p on MCF-7 Cell Proliferation** Nisa Faheem, Rajiv Trehan; Advisor(s): C. Robyn Fischer
A-115	C22	**I Spy: A Functional Magnetic Resonance Imaging Study of Hippocampal Activation During a Spatial Memory Task** Vedhik Kodavatiganti, Shveta Thakkar; Advisor(s): Todd Parrish
A-117	C13	**Deoxycholic Acid Alters DNA Methylation in Caco2BBE Cells** Yan Lin Feng; Advisor(s): Eugene Chang, Kyle Dolan

10:25 - 10:40

Room	ID	
A-119	C01	**Characterizing Astrocyte Morphology in Hippocampal Area CA1 in Wild Type and an Alzheimer's Disease Transgenic Mouse Model** Timothy Akintilo; Advisor(s): C. Savio Chan, John Disterhoft, Jason Pitt
A-131	Q12	**Using Root to Visualize the Performance of Ionization Characters** Daniel Sohn; Advisor(s): Brendan Kiburg, Tammy Walton
A-133	P02	**Gray Matter Volumes in Glioblastoma Multiforme Patients Using Structural Imaging** Lauren Bystrom, Hanna Flatness; Advisor(s): Lei Wang, C. Paula de los Angeles
A-135	O06	**Effects of Exercise and Manual Therapy on Weight Loss and Lower Extremity Functional Mobility** Lija Hoffman; Advisor(s): Amy Anichini, Lela Fausze, Ben Wax
A-138 Acad. Pit	S02	**Possible Racial and Ethnic Segregation on Social Media With Multi-Color Populations** Susriya Gangireddy; Advisor(s): Narendra Jaggi
A-147	C11	**The Effect of Omega-3 and Omega-6 Fatty Acids on the Expression of ERK and AKT in Human Pancreatic Cells** Chase Engelbrecht; Advisor(s): Paul Grippo
A-149	O08	**The Correlation Between Neonatal Disease Severity and the ABO Blood Group** Divya Jasthi, Faith Leslie, Hope Leslie; Advisor(s): Kacie McMahon, Jonathan Muraskas, Renae Reisig
A-151	P05	**Effect of Varying Musical Stimuli on Memory Recall** Gloria Choi, Kirstin Johnson; Advisor(s): Elise Gagnon, Joel Voss
B-206 Lect. Hall	I04	**The Elastic Properties of Silicon Functionalized Graphene Nano-Platelet Reinforced Potassium Geopolymer by the Impulse Excitation** Erik Seungwoo Nam; Advisor(s): Shinhu Cho, Waltraud Kriven
D-103	O07	**Mechanisms of Host-Viral Interactions in the Gut Leading to Loss of Oral Tolerance: A Prerequisite in Celiac Disease Pathogenesis** Fengling Hu; Advisor(s): Romain Bouziat, Reinhard Hinterleitner, Bana Jabri
D-107	C21	**Classification of Breast Cancer into Molecular Subtypes and the Role of Ki-67 Protein in Tumor Progression** Chinyere Kemet, Stefanie Ochoa; Advisor(s): Galina Khramtsova, Olufunmilayo Olopade, Elisabeth Sveen
D-110	Q13	**Investigating Electrical Breakdown in High Voltage Feedthroughs in Liquid Argon** Alan Yang; Advisor(s): Sarah Lockwitz, Jennifer Raaf
E-115 Kids Inst.	R07	**The Effects of Depression on Memory in Dementia Patients** Kaitlyn Schmieder; Advisor(s): Maureen Lacy, Todd Nader

10:50 - 11:05

Room	ID	
A-113	E09	**A Study of the Properties of Films for Use in Organic Light Emitting Diodes** Liam McParland, Luke Morrical; Advisor(s): C. Robyn Fischer, John Thurmond
A-115	P01	**Use of a Novel Magnetic Resonance Imaging Compatible Head-Positioning Device for Three-Dimensional Kinematic Analysis of the Cervical Spine in Axial Rotation** Jyotsna Bitra, Jessica Phung; Advisor(s): Todd Parrish, Kenneth Weber
A-117	C32	**Investigating the Impact of Bacteria on Gene Expression in Germ-Free and Specific-Pathogen-Free Enteroids and Colonoids** Mit Patel; Advisor(s): Candace Cham, Eugene Chang
A-119	P21	**The Impact of Traumatic Brain Injury on the Morphology of Mouse Astrocytes** Ahsan Qureshi; Advisor(s): C. Savio Chan, Jason Pitt
A-121	G02	**Algorithm for Market Dynamics in the Trade-At-Settlement Futures Markets** Huajie Huang; Advisor(s): David Lorentzen
A-133	P20	**Changes in Resting State Functional Connectivity in the Default Mode Network From Chemotherapy-Induced Cognitive Impairment in Breast Cancer Patients** Khusbu Patel; Advisor(s): Alexandra Apple, Lei Wang
A-135	C04	**The Long-Term Effect of Maternal Exposure of Ethanol in the Fruit Fly, *Drosophila melanogaster*** Samantha Arrez, Luselena Perez; Advisor(s): Vandana Chinwalla
A-138 Acad. Pit	S03	**Does Student Dress Affect Teacher Grading?** Cameron Hudgins; Advisor(s): Deborah Scarano
A-147	I03	**Thermodynamic Analysis of the Heusler Alloy Nickel-Manganese-Tin** Drake Eidukas; Advisor(s): Susan Meschel, Philip Nash
A-149	I09	**Development of Open Source Ultrasonic, Dust, and Solar Panel Sensors** Mylee Rolock; Advisor(s): Akram Ali, Brent Stephens, Zach Zanzinger
A-151	C03	**Meta-Analysis of mRNA Levels of Iron Metabolism Genes in Prostate Cancer** Waleed Ali; Advisor(s): Andre Kajdacsy-Balla, Virgilia Macias, William Walden
A-155	C41	**Determination of the Optimal Method of Transformation for MCF-10A Cells** Huiran Zhang; Advisor(s): Abde Abukhdeir, Sanja Turturro
B-206 Lect. Hall	A02	**Gene Expression Analysis of Histone Modifiers in Breast Cancer** Sachin Govind; Advisor(s): Elizaveta Benevolenskaya
D-107	P09	**Determining Offset Analgesia With Dual Stimuli Applied to Opposite, Proximal, and Distal Locations** Sarah Eaton; Advisor(s): Vania Apkarian, Bogdan Petre
D-110	B01	**Measuring Microbial Content of Water With Resazurin-Based Absorbance Photometry** Sanjay Kottapalli, Alan Yang; Advisor(s): Mark Carlson

10:50 - 11:05

Room	ID	
E-115 Kids Inst.	Q10	**Scanning Neutrino Events and Experimental Data: Monte Carlo Comparisons for Proton Scattering With Iron, Carbon, and Nickel** Alan Ren; Advisor(s): Minerva Betancourt

11:15 - 11:30

Room	ID	
A-113	C38	**The Effects of A4VSOD1 Mutant Protein Incorporation on Calcium Ion Membrane Conductance** Shelly Teng; Advisor(s): Michael Allen, Ana Correa, Jacob Riehm
A-115	P22	**Statistical Differences in the Resting State Network of Iraqi Veterans and Former National Football League Players** Malavika Ramnath; Advisor(s): Todd Parrish
A-117	O14	**Toxicity of Oxaliplatin Resulting in Peripheral Sensory Neuropathy Detected Through Nerve Conduction Studies and Needle Electromyography** Mitchell Sun; Advisor(s): Susan Lis, David Ronin
A-119	C37	**Modeling the Interaction Between Insulin and Insulin-Degrading Enzyme: A Molecular Dynamics Simulation Study** Ranjani Sundar; Advisor(s): R. Stephen Berry, Esmael Haddadian
A-121	G07	**Existence of Post-Earnings Announcement Drift in Brazilian Financial Markets** David Xu; Advisor(s): Brian Green, Maxwell Rhee
A-131	Q09	**Discerning Cosmic Rays From Neutrino Beam Events in the NOvA Experiment** Ashrita Raghuram; Advisor(s): Maury Goodman, Louise Suter
A-135	A01	**The Effect of the Small Molecule Drug 54118 on the C-X-C Chemokine Receptor Type 4 in the Context of Cancer Cell Metastasis** Tiffany Ding, Susriya Gangireddy; Advisor(s): Richard Miller, Andrew Shum
A-138 Acad. Pit	F04	**Investigations on and Repairs to Issues With the Current Residential Checking System at IMSA** Rakesh Chatrath, Tiger Shi; Advisor(s): Fred Yankowski
A-147	I12	**Effect of Double Aging and Room Temperature Aging on Properties and Stress Corrosion Cracking of the Aluminum Alloy AA7075** John Valin; Advisor(s): John Hasier, Susan Meschel, Philip Nash
A-149	E05	**Fabrication of a Methane Sensor by Zinc Oxide Functionalization of Multi-Walled Carbon Nanotubes** Ashu Gupta; Advisor(s): Ralu Divan, Md Humayun
A-151	C30	**The Effect of Methionine-Choline Deficient Diet on Hepatic Inflammations and Liver Injuries in Phosphatidylethanolamine N-Methyltransferase Deficient Mice** Seong Park; Advisor(s): Richard Green

11:15 - 11:30

Room	ID	
A-155	Q05	**Determining the Performance of Muon Ionization Detectors With Different Thresholds and Straw Diameters Based on Time and Spatial Resolution** Violet Konopka; Advisor(s): Brendan Casey, Brendan Kiburg, Mandy Rominsky, Tammy Walton
B-206 Lect. Hall	O05	**The Association Between a Single Nucleotide Polymorphism of the CALC 1 Gene and Malaria in the South Indian Population** Lohitha Guntupalli; Advisor(s): Ch. Venkataramana Devi, Prasad Kotiklapudi
D-103	C33	**Exploration of Acetyl-CoA Carboxylase to Develop Fungicides for Agriculture** Samuel Qian; Advisor(s): Piotr Gornicki, Robert Haselkorn
D-107	F10	**The Combinations and Modifications of Delays** Arun Kumar; Advisor(s): Ben Sutherland
D-110	C23	**Mechanisms of WDR5- and PKN1-Driven Growth in Prostate Cancer** Sanjay Kottapalli; Advisor(s): Debabrata Chakravarti, Jiyoung Kim
E-115 Kids Inst.	R02	**The Effects of Social Exclusion on Emotion Intelligence and Perceived Likeability** Alice Gong, Crystal Gong; Advisor(s): Elaine Cheung, Wendi Gardner

12:30 - 12:45

Room	ID	
A-115	C09	**Early Oligomer Detection in Alzheimer's Disease Using Intranasal Probes** Esther Chung; Advisor(s): William Klein, Kirsten Viola
A-119	C39	**The Effect of Parental Age on Mental Capabilities in Children** Andy Xu; Advisor(s): Huayun Chen, Chunyu Liu
A-131	Q03	**Causes of Cosmic Muon Detection Rate Loss in the MINOS Particle Detector Experiment** Mobolaji Bankole; Advisor(s): Maury Goodman
A-135	P13	**Role of Oligodendrocytes in Ischemic Brain Repair** Cindy Ho; Advisor(s): Richard Miller
A-149	Q11	**Free Energy Landscapes of Self-Drying Pores** Dennis Rich; Advisor(s): Paul Jones, Neelesh Patankar
*	F14	**An Algorithm to Find the Height of a Multihop Wireless Network's Strip Yielding Maximum Efficiency** Lydia Stone; Advisor(s): Peng-Jun Wan
B-206 Lect. Hall	I08	**Designing a DC-DC Converter for the Mu2e T-Tracker** Sattvic Ray; Advisor(s): Aseet Mukherjee
D-103	Q14	**Heavy Flavor Content in Events With a Z Boson and Two Jets** Timothy Zhou; Advisor(s): Ashish Kumar
D-107	P18	**Examining the Specificity of N-Methyl-D-Aspartate 2B Receptor Targeted Primary Antibodies Using Fluorescent Microscopy** Naima Muckom; Advisor(s): Amanda Gross, Roger Kroes, Joseph Moskal

12:30 - 12:45

Room	ID	
D-110	T03	**Designing Life Support Systems on a Space Settlement** Erich Remiker, Vinay Sama; Advisor(s): Eric Hawker
E-115 Kids Inst.	F05	**Downed Aircraft: A Search and Rescue Flight Path Interpolation Tool** Daniel Costa; Advisor(s): Pierre Bierre, Namrata Pandya

12:55 - 1:10

Room	ID	
A-113	C06	**The Effects of Growing Method on the Crop Efficiency in Legume Grain Crops** Grace Carlberg, David Kodama; Advisor(s): John Thurmond
A-115	P24	**Correlation of Memory Dysfunction and Aβ Build-Up in an Alzheimer's Disease Transgenic Mouse Model** Jason Wu; Advisor(s): William Klein, Kirsten Viola
A-117	R08	**The Effects of State and Trait Anxiety on Subjective Effects of Alcohol Use** Aniruddha Shekara; Advisor(s): Melissa Miller, Harriet de Wit
A-121	G01	**Statistical Arbitrage and Execution in Exchange-Traded Fund Markets** Timothy Gietl; Advisor(s): Brian Green, Maxwell Rhee
A-133	F08	**Designing Artificial Intelligence Algorithms That Outperform Humans in Simulated Real-World Scenarios** Kushagra Gupta, Noor Michael; Advisor(s): Phadmakar Patankar
A-147	F03	**A Cloud-Based Front End for Real-Time Activity Recognition From Wearable Sensor Data** Arun Arjunakani; Advisor(s): Mark Albert
A-151	K01	**A Chemical Equilibrium Analysis of Mercury Adsorption Onto *Escherichia coli* Surfaces** Katherine Su; Advisor(s): Jean-Francois Gaillard, Sara Thomas
B-206 Lect. Hall	E13	**Structure and Activity of Sulfur-Based Radicals in Small Biological Compounds** Aspen Wheeler; Advisor(s): Michael Lesslie, Victor Ryzhov
D-103	O11	**Bacterial Coinfection and Antimicrobial Resistance in Patients With Viral Community-Acquired Pneumonia** Eleanor Naudzius; Advisor(s): Jeffrey Semel
D-107	R04	**The Variability in Heart Rates of Officers During Workdays Due to the Severity of Weather, Traffic, and the Situation** Kevin Hinterlong; Advisor(s): James Bondi
D-110	D01	**The Effect of Public Announcements on a Cell Phone Manufacturer's Performance in the Stock Market** Calvin Zhu; Advisor(s): Pradeep Chintagunta
E-115 Kids Inst.	Q08	**The Search for Standard Model Higgs Events in Associated WH Production Resulting in the b Anti-b Decay Channel With DØ Data** Dawson Patel; Advisor(s): Ryuji Yamada

1:20 - 1:35

Room	ID	
A-113	C05	**The Effect of Addition of a Marketed Energy Booster on the Growth Rate and Total Growth of Holstein Heifers** Grace Carlberg; Advisor(s): Henry Hoene
A-115	P03	**Altered Brain Activity Between Language Tasks Project How Individuals in a Minimal Conscious State Process Language** Kristin Carlson; Advisor(s): Todd Parrish, Xue Wang
A-117	R03	**Inhibitory Control as a Predictor of Drug Reward Following Amphetamine, Ethanol, and Tetrahydrocannabinol** Faithe Hill; Advisor(s): Jessica Weafer, Harriet deWit
A-119	C40	**The Effect of Endothelin-1 on Canine Atrial Myocytes** Andy Xu; Advisor(s): Gary Aistrup, Bill Marszalec, J. Andrew Wasserstrom
A-121	G03	**Extracting Zero Rates and Discount Factors From Treasury Bonds** Camden Ko; Advisor(s): David Lorentzen
A-131	C15	**Halting Herpes Simplex Virus Cell-to-Cell Fusion With Zinc Oxide Nanoparticles** Cammille Go; Advisor(s): Deepak Shukla
A-133	F11	**Performance Comparison of the Transmission Control Protocol and User Datagram Protocol in Supporting a Video Streaming System Programmed Using Java** Angela Lee, Isabella Lee; Advisor(s): Phadmakar Patankar
A-135	L04	**Economic Implications of Chinese Presence in Africa: Foreign Aid, Migration, and Resource Extraction** Ziang Wang; Advisor(s): Ralph Austen
A-138 Acad. Pit	S05	**The Understanding of African American Females' Journeys in Pursuit of a Career in the STEM Fields** Trennedy Kleczewski; Advisor(s): Adrienne Coleman, Anita White
A-147	C42	**The Mechanisms to Break the Vertebrate Ground Plan by Shifts of *Hox* Code in Skates, *Leucoraja erinacea*** Mickinney Zhang; Advisor(s): Tetsuya Nakamura, Neil Shubin
A-149	C36	**The Effects of Deleting Foxo1 in the Pituitary of Mice at Embryonic Day 14.5** Megan Smiley; Advisor(s): Buffy Ellsworth
A-151	I13	**Composition Analysis of Solid Oxides Deposited Through Atomic Layer Deposition** Thomas Wan; Advisor(s): Sathees Selvaraj, Christos Takoudis
B-206 Lect. Hall	O12	**Analysis of the Immune Response to Methicillin Resistant *Staphylococcus aureus* Surface Proteins FnBPA, ClfA, SdrE, and SdrD for Vaccine Development** Keelyn O'Brien; Advisor(s): Lukasz Sewera, Chris Wiethoff
D-103	I05	**Evaluation of the Efficiency of Contemporary Contact Precautions and the Development of a New Barrier Precaution Prototype** Eleanor Naudzius; Advisor(s): Peter Clancy

1:20 - 1:35

Room	ID	
D-107	M01	**The Challenges of Apprehending Identity Thieves: Methods and Techniques That Police Officers Can Use to Investigate Identity Theft** Joseph Longo; Advisor(s): James Bondi
D-110	I07	**Providing Power for an Ultraviolet Light Water Purifier for the Developing World** Sean Potempa, Grant Williams; Advisor(s): Mark Carlson
E-115 Kids Inst.	P11	**The Effects of Functional Electrical Stimulation on Hand Control** Zeidy Garcia; Advisor(s): Jun Yao

1:45 - 2:00

Room	ID	
A-113	E03	**Reducing Background Adsorption by Condensing Ethylene Glycol on Silica With Grafted Calixarenes** Ryan Franks; Advisor(s): Justin Notestein, Anthony Thompson, Rachel Watson
A-115	P10	**Amyloid Precursor Protein and Amyloid-β Oligomer Concentrations are Connected in Developing Chicken Embryos** Nathan Errampalli, Michael Qian; Advisor(s): Sydney Doe, William Klein, Kirsten Viola
A-117	F01	**Innate Learning: Understanding Binocular Visual Development Through Efficient Coding** Jorge Adorno; Advisor(s): Mark Albert
A-119	O09	**Burn Injury Alters the Intestinal Microbiome and Increases Gut Permeability and Bacterial Translocation** Omair Khan; Advisor(s): Abigail Cannon, Mashkoor Choudhry, Zackary Earley, Adam Hammer, Niya Morris
A-121	P06	**Differentiation of Angiomatous and Non-Angiomatous Meningiomas Using High b-Value Diffusion Imaging With a Fractional Order Calculus Model** Nicholas Damen; Advisor(s): Frederick Damen, Yi Sui, Xiaohong Joe Zhou
A-131	C08	**Modeling Herpes Simplex Virus Infection to Determine Antiviral Efficacy of Zinc Oxide Nanoparticles** Jason Chen, Angad Garg; Advisor(s): Deepak Shukla
A-133	T04	**Using a Galactic Model to Search for Red Clump Stars in the Sagittarius Stream** Anabel Rivera; Advisor(s): James Annis, Tom Diehl
A-135	Q02	**The Effect of Shear to Bulk Modulus Ratio on the Crumpling of a Sheet** Vikram Anjur; Advisor(s): Irmgard Bischofberger, Sidney Nagel
A-138 Acad. Pit	R05	**The Neuropsychological Impacts of Suicidal Ideation of Urban Homeless Youth** Daniel Holley; Advisor(s): Scott J. Hunter
A-147	C20	**HIV-1 Expression Profiling by High Throughput Sequencing on *in Vitro* Infected CD4+ T Cells** Vivian Jin; Advisor(s): Eunyoung Kim

1:45 - 2:00

Room	ID	
A-149	C29	**Hepatic XBP-1s Regulation and Response to Deoxycholic Acid and Cholic Acid Feeding to Mice** Seong Park; Advisor(s): Richard Green
A-151	F07	**Minimal Probing Algorithms for Membership Queries on Large Sets** Sachin Govind; Advisor(s): Noah Prince
B-206 Lect. Hall	L03	**An Examination of the Source of the Instability of the Mexican Government After Independence From Spain** Cristal Quinones; Advisor(s): Eric Smith
D-103	G04	**Effects of Weather Forecasts on the Planting Decisions of Farmers** Vivian Liu; Advisor(s): Tatyana Deryugina
D-107	C27	**Anatomy and Biomechanics of the Feeding Behavior of the Alligator Gar, *Atractosteus spatula*** Samantha Medina; Advisor(s): Justin Lemberg, Mark Westneat
D-110	B02	**Improving Cancer Cell Detectability in Fluorescence Guided Brain Tumor Resection Surgery** Sabrina Matthews; Advisor(s): Kenneth Tichauer, Clover Xu
E-115 Kids Inst.	G05	**The Effect of Competitive Natural Gas Prices on Air Quality and Public Health in the United States** Daniel Pechi; Advisor(s): Steve Cicala

2:10 - 2:25

Room	ID	
A-113	E04	**The Effect of Surface Treatments on Metal Catalysts for the Epoxidation of Cyclohexene** Ryan Franks; Advisor(s): Justin Notestein, Nicholas Thornburg
A-117	F02	**Using WProf to Analyze Page Loading Time in Webpages** Arun Arjunakani; Advisor(s): Alexsandar Kuzmanovic
A-119	A03	**Design of Short Peptide Amphiphile Fibers With Transition Metal Active Sites** Alexandra Johnson; Advisor(s): H. Christopher Fry
A-121	E08	**The Effect of Benzoyl Peroxide and Salicylic Acid on MCF-7 Epithelial Cells** Jaida Lewis, Bria Williamson; Advisor(s): Anita White
A-131	F13	**Extending Java to Include Traits for Method Reuse** Kody Puebla; Advisor(s): John Reppy
A-133	C16	**Functional Response of *Toxorhynchites rutilus* to Prey Density and the Effects of Container Size** Jonah Goughnour; Advisor(s): Steven Juliano, Geoff Ower
A-135	C24	**Genetic Comparison of Various Nitric Oxide-Adapted Cancer Cells Using *in Silico* Techniques** Niresh Kuganeswaran; Advisor(s): James Radosevich

2:10 - 2:25

Room	ID	
A-138 Acad. Pit	J01	**This is the End: Gendered Closure in Victorian Literature, 1840-1859** Ana Curtis; Advisor(s): Leah Kind
A-147	F16	**Software Rejuvenation in Cloud Computing** Jacqueline Vega; Advisor(s): Shangping Ren
A-149	H01	**Creating the Customer Archetype for English e-Learning in India** Puja Mittal; Advisor(s): Saurabh Chopra, Apar Sureka
A-151	P12	**Effects of Acute Ethanol Exposure on the Expression of the Gamma Amino Butyric Acid Receptor Subunits in Rat Cortex** Rajangad Gurtatta; Advisor(s): Subhash Pandey, Tara Teppen
B-206 Lect. Hall	F12	**The Singularity: What is it, Where Will it Come From, and How do You Survive?** Vishal Patel, Ray Sun; Advisor(s): Mike Ososky
D-103	S04	**Cinematocracy: Social and Political Anxieties About Russia in Film** Nicholas Kiene, Vivian Liu; Advisor(s): Malynne Sternstein
D-107	I11	**Design and Construction of a Water Purification System Utilizing Ultraviolet Light** Nikhilesh Thota, Franklin Ye; Advisor(s): Mark Carlson
D-110	L01	**Roles of Women Worldwide in World War II** Jamie Candler; Advisor(s): Claiborne Skinner
E-115 Kids Inst.	I01	**Investigation of Potential Benefits of Unmanned Aerial Vehicles** Kevin Chen; Advisor(s): James Gerry

* Lydia Stone is attending the Junior Sciences and Humanities Symposium National Conference and will present at an alternate time.

Biochemistry

A01
The Effect of the Small Molecule Drug 54118 on the C-X-C Chemokine Receptor Type 4 in the Context of Cancer Cell Metastasis

Presenter(s)
Tiffany Ding, Illinois Mathematics and Science Academy
Susriya Gangireddy, Illinois Mathematics and Science Academy

Advisor(s)
Richard Miller, Northwestern University
Andrew Shum, Northwestern University

The activation of a cell's C-X-C chemokine receptor type 4 (CXCR4) by the natural ligand stromal cell-derived factor 1 is known to help guide these cells throughout the body. These receptors, when activated on cancer cells, promote metastasis. We used calcium imaging to determine the effect of the drug agonist 54118 on the melanoma cell line C8161. Preliminary calcium imaging results and analysis suggest that the agonist 54118 stimulates robust responses from all cells at a concentration of 10 micromolar, slight responses from the majority of cells at 1 micromolar, and very slight responses from the majority of cells at 0.1 micromolar. These results are used to generate a dose response curve, which shows the correlation between the concentration of the drug 54118 and the effectiveness of stimulating cancer cell response. We conclude that the agonist 54118 is a strong stimulator of cancer cells and could be used for further research.

A02
Gene Expression Analysis of Histone Modifiers in Breast Cancer

Presenter(s)
Sachin Govind, Illinois Mathematics and Science Academy

Advisor(s)
Elizaveta Benevolenskaya, University of Illinois at Chicago

Epigenetic events such as post-translational histone modification play crucial roles in tumorigenesis. Histone modifying enzymes enhancer of zeste-homolog 2 (EZH2), histone lysine-specific demethylase 5A (KDM5A), and 5B (KDM5B) are highly deregulated in different cancers. Combinations of single, double, and triple knockdowns of KDM5A, KDM5B, and EZH2 were studied in neoplastic transformation of MCF7 breast epithelial cell lines. A hallmark of breast cancer is the epithelial-mesenchymal transition (EMT), where epithelial cells transform into mesenchymal cells. Quantitative real-time polymerase chain reaction (real-time qPCR) was used to validate the knockdown of the studied genes as well as to study the effect of the combinations of knockdowns on the EMT. Several real-time qPCR experiments were run to examine mean fold change difference in expression of epithelial and mesenchymal genes. As expected, the single EZH2 knockdown resulted in down-regulation of mesenchymal markers and up-regulation of epithelial markers. Series of additional real-time qPCR experiments are being conducted to quantify the effect of combinatorial knockdowns. RNA sequencing experiments are being planned to further study gene expressional changes. This work will have a potential impact in the validation of these genes as drug targets for breast cancer treatment.

A03
Design of Short Peptide Amphiphile Fibers With Transition Metal Active Sites

Presenter(s)
Alexandra Johnson, Illinois Mathematics and Science Academy

Advisor(s)
H. Christopher Fry, Argonne National Laboratory

Peptide amphiphiles are peptide-based molecules with the ability to self-assemble into long aspect ratio nanofibers. Binding inorganic molecules is an important quality of structure and function in proteins. The purpose of this study was to engineer short amphiphiles that can bind transition metal ions. Short peptides were synthesized with automated solid phase peptide synthesis. A variety of morphology and characterization tests, including circular dichroism spectroscopy, ultraviolet-visible (UV-vis) spectroscopy, infrared spectroscopy, and scanning electron (SEM) and atomic force microscopies (AFM) were conducted to determine structural properties. The peptide C_{16}-$AHLHL_3K_3$ showed evidence of β-pleated sheet formation under aqueous conditions when induced with Tris buffer or NH_4OH. Then, the preformed β-sheets were treated with solutions of transition metals, including $CoCl_2$ and $ZnCl_2$. Binding of $CoCl_2$ was confirmed with UV-vis spectroscopy. Morphological characterization under SEM and AFM showed the formation of fibrous materials before and after transition metal binding, indicating that fibrous material held shape when binding occurred. The peptide C_{16}-$AHLHL_3K_3$ forms β-pleated sheet type fibers under certain conditions, which appears to provide the ability for transition metal ions to bind. A peptide such as this could have potential enzymatic capabilities.

A04
Levels of Expression of Genes in Mice and Humans That Cause the Formation of Prostate Tumors

Presenter(s)
Julian Pacheco, Illinois Mathematics and Science Academy

Advisor(s)
Hannah Brechka, University of Chicago
Donald Vander Griend, University of Chicago
Anthony Williams, University of Chicago

Phosphotase and tensin homolog (*PTEN*) has been implicated in the formation of prostate cancer. Transgenic mice with either *PTEN* flanked with Lox-p sites and *probasin creatin recombinase* (*PB Cre*) were used to generate mice containing both constructs. *Cre* recognizes Lox P sites and cuts *PTEN* gene creating a *PTEN* mutant. I analyzed DNA from progeny of mice using polymerase chain reaction and gel electrophoresis to genotype those with *Cre* DNA and the deleted *PTEN* gene. This study is aimed at finding correlation between the mutated *PTEN* and the risk of developing prostate cancer. After genotyping twenty mice, one was found to have the *PTEN* mutant *CRE* combination. On computerized tomography scan we found that this mouse had developed a large prostate tumor. Mice are still being genotyped to confirm our results. In humans, *homeobox protein meis 3* (*Meis 3*) has been associated with the initiation of prostate cancer. Real time polymerase chain reaction was used to determine the expression of *Meis 3* in cancerous and noncancerous cell lines and test whether there were differences in expression. The research is still being conducted. This project helps identify genes involved in prostate cancer, with the long term goal of developing new strategies for cancer prevention and predicting cancer progression.

A05
Analysis of the *sypK* Gene in *Vibrio fischeri* Biofilms and Motility

Presenter(s)
Aishwarya Raj, Illinois Mathematics and Science Academy

Advisor(s)
Cecilia M. Thompson, Loyola University Chicago
Karen L. Visick, Loyola University Chicago

Biofilms, or adherent communities of bacteria, pose serious problems as they exhibit increased resistance to antibiotics. One model used to study biofilms is the bacterium *Vibrio fischeri*, which contains a set of genes, *syp*, for the production of a polysaccharide necessary for biofilm formation. The *sypK* gene is predicted to encode a flippase that transports the polysaccharide across the inner membrane. *SypK* is required for biofilm formation and is also associated with increased motility. It was theorized that through the generation of mutant *sypK* alleles, one of these phenotypes could be conserved while the other was silenced. A *sypK*-expressing plasmid was mutagenized. Several mutant *sypK* plasmids were identified that failed to promote biofilms and/or exhibited an altered ability to promote motility. The *sypK* gene was sequenced to identify predicted changes at the protein level. No mutations existed despite biofilm formation being silenced. One possibility is that altered *sypK* expression could increase motility while decreasing biofilm formation. In current work, this hypothesis is being tested via strains in which *sypK* expression is controlled by an exogenous inducer, IPTG, and determining if altered sypK levels cause a defect in biofilm formation.

A06
Optimizing Expression of Cyanobacterial Light-Harvesting Complex Proteins in *Escherichia coli*

Presenter(s)
Taylor Reyes, Illinois Mathematics and Science Academy
Nicole Tartaglia, Illinois Mathematics and Science Academy

Advisor(s)
C. Robyn Fischer, Illinois Mathematics and Science Academy

When present together, the three proteins LP502, Ho1, and PcyA form the light-harvesting complex LCM in cyanobacteria. This system constitutes a major part of the terminal energy acceptor in phycobilisomes (PCB), which are complexes responsible for much of the light absorption in photosystem II. In this investigation, our goal is to optimize environmental conditions for maximum light absorption through expression of these proteins in *Escherichia coli*. We tested the expression of LCM under varying temperature, light intensity and wavelength, pH, and the presence of several metal ions. Maximizing the expression of these proteins in *E. coli* can lead to applications relating to the production and effectiveness of biofuel and other biomaterials.

Bioengineering

B01
Measuring Microbial Content of Water With Resazurin-Based Absorbance Photometry

Presenter(s)
Sanjay Kottapalli, Illinois Mathematics and Science Academy
Alan Yang, Illinois Mathematics and Science Academy

Advisor(s)
Mark Carlson, Illinois Mathematics and Science Academy

In this investigation, we developed an alternative method for approximating the extent of biological contamination of a solution based on the rate of reduction of the chemical Resazurin to the chemical Resorufin. To this end, absorbance spectra of pure Resazurin and Resorufin were compared to metabolic kinetic data. Absorbance of the test samples at 570nm and 600nm over time were fitted to the solution of an empirically designed differential equation representing the conversion of Resazurin to Resorufin, which incorporated a contamination parameter. This function is utilized by our compact, low-cost, LED-based absorbance photometer designed for contamination measurement outside of a laboratory environment. It measures transmittance while cutting interference using operational amplifiers and filtering. The measurement, taken after 15 minutes of incubation, is then translated to a concentration of Resorufin, interpreted in the context of our differential equation, and used to calculate the value of the contamination parameter. The volume of *E. coli* broth added to the test water sample containing 25μM Resazurin positively correlated with the calculated concentration of Resorufin after 15 minutes of incubation and with the associated contamination parameter. We conclude that quantification of Resazurin metabolism with our absorbance photometer using our empirical equations is a reasonable measure of the extent of microbial contamination in water.

B02
Improving Cancer Cell Detectability in Fluorescence Guided Brain Tumor Resection Surgery

Presenter(s)
Sabrina Matthews, Illinois Mathematics and Science Academy

Advisor(s)
Kenneth Tichauer, Illinois Institute of Technology
Clover Xu, Illinois Institute of Technology

The removal of tumors currently relies on a doctor's instinct and experience to visually spot the difference between normal and abnormal tissues. To increase visual differences and help surgeons increase the extent of tumor removed, a paired-imaging agent approach is being investigated, where a cancer targeted fluorescent imaging agent is co-injected with a control, untargeted, imaging agent. The control imaging agent helps account for any physiological effects that affect the cancer targeted agent. This approach provides optimal contrast to help identify cancer from healthy tissue during brain cancer surgery. In this study, the human glioma cell line U251, which expresses red fluorescent protein, was implanted in the brains of immune-compromised mice and grown for five weeks, allowing the diameter to grow to five millimeters. A cocktail of cancer targeted and control fluorescent imaging agents was administered in the mice intravenously. Three hours post-injection, brains were excised, sliced, and imaged on a confocal fluorescent imaging system. They were analyzed using functions in the computer program MATLAB. Preliminary results suggest that targeted tracers can leak across the blood-brain barrier and out of the brain tumor area. With the correction of the untargeted tracer, paired-imaging methods can help provide a visual edge to tumors.

Biology

C01
Characterizing Astrocyte Morphology in Hippocampal Area CA1 in Wild Type and an Alzheimer's Disease Transgenic Mouse Model

Presenter(s)
Timothy Akintilo, Illinois Mathematics and Science Academy

Advisor(s)
C. Savio Chan, Northwestern University
John Disterhoft, Northwestern University
Jason Pitt, Northwestern University

Astrocytes are a specialized type of glia that are vital to normal brain function. Widespread incapacitation of astrocytes leads to seizures and death. Despite the importance of astrocytes, the effects of Alzheimer's disease and traumatic brain injury (TBI) have not been studied. Astrocytes were collected from brain slices from wild-type, 5xFAD, and TBI mice, and sulforhodamine 101 dye was used to make the astrocytes more visible. They were then photographed using a confocal microscope and converted into image stacks. The stacks were opened using the image processor Fiji, and the Simple Neurite Tracer was used to trace the astrocytes' processes. The tracings were analyzed via Sholl analysis, and the data from the analysis was visualized using GraphPad Prism. Preliminary results show that sham-blasted (TBI control) mice of age 3 months had significantly higher total branch lengths than the blasted (TBI) mice; the sham-blasted mice had an average total branch length of 1205.32 microns, while the blasted mice had an average total branch length of 612.12 microns. This result contradicts our hypothesis that the trauma would cause reactive astrocytosis. Astrocytes from the other groups will be analyzed to find other trends in total branch length and critical radius.

C02
Annotating Single Nucleotide Polymorphisms to Better Define Associations for Arsenic Metabolism Observed in Genome-Wide Association Studies

Presenter(s)
Harith Alappat, Illinois Mathematics and Science Academy

Advisor(s)
Brandon Pierce, University of Chicago

Single nucleotide polymorphisms (SNPs) are genetically variable individual base pairs in the human genome that differ from person to person. The different alleles, or pair possibilities, are known to differ, and they can lead to differences in human traits and disease susceptibility. Results from previous genome-wide association studies show that large groups of correlated variants in close proximity to one another often show association in the human traits. Using software such as ANNOVAR, HaploReg v2, and RegulomeDB, these previously identified SNPs can be annotated to better understand their functions. This study aimed to characterize SNPs found in a previous genome-wide association study, in which groups of correlated SNPs showed association with arsenic metabolism efficiency. Results are still being found. The results of this study will more clearly indicate the specific individual SNP that affects arsenic metabolism efficiency. These results show the possibility of using publically available databases and software to identify specific SNPs that may affect human traits, including arsenic metabolism, which can help estimate risk of arsenic poisoning in human populations.

C03
Meta-Analysis of mRNA Levels of Iron Metabolism Genes in Prostate Cancer

Presenter(s)
Waleed Ali, Illinois Mathematics and Science Academy

Advisor(s)
Andre Kajdacsy-Balla, University of Illinois at Chicago
Virgilia Macias, University of Illinois at Chicago
William Walden, University of Illinois at Chicago

High iron levels have been shown to promote cancer metastasis. Through the cancer database Oncomine™, mRNA levels of iron metabolism-related genes were examined in cases of prostate cancer in regards to Gleason Grading Score, a measure of tumor aggressiveness. Along with t- tests to compare the differential between the mRNA gene expression values, meta-analysis was conducted for each of the genes to obtain a global p-value regarding the overexpression or underexpression of the value for samples with a histologic score of 6 or below (better prognosis) versus 8 and above (worse prognosis). T-tests showed that for transferrin receptor 1 (TFRC), seven out of eleven databases showed an increase in samples of prostate cancer with a higher grade, with four out of the seven being significant ($p<0.05$). The group with a score of 8 and above also had an increase in expression for six out of six datasets for ferritin light chain and six out of eight for ferritin heavy chain, with three out of six and one out of eight datasets begin significant, respectively. The global p-values from the meta-analysis for TFRC and ferritin light chain were significant ($p<0.05$), but not for ferritin heavy chain. This upregulation on the mRNA level leads us to believe that prostate cancers with a higher grade (a worse progression) have a higher need for iron, leading to an increase in the expression of iron metabolism-related genes.

C04
The Long-Term Effect of Maternal Exposure of Ethanol in the Fruit Fly, *Drosophila melanogaster*

Presenter(s)
Samantha Arrez, Illinois Mathematics and Science Academy
Luselena Perez, Illinois Mathematics and Science Academy

Advisor(s)
Vandana Chinwalla, Illinois Mathematics and Science Academy

Alcohol consumption in pregnant women is known to cause long-term effects for the child. The fruit fly, *Drosophila melanogaster*, was used as a model for the effects of toxins during development. We exposed adult flies to three different concentrations of ethanol (0%, 5%, 10%) for forty-eight hours. The fertilized eggs laid by these adults were allowed to develop on normal food containing different concentrations of ethanol and the newly emerged progeny was tested for its locomotion and fertility. Locomotion was tested by negative geotaxis assay and is indicative of any impairment. Preliminary results show that the flies reared on ethanol emerge later than those reared on water suggesting a delay in development. The number of offspring that hatched when developed on ethanol was considerably less compared to those in the control group. Data analysis for negative geotaxis is currently underway. These results suggest that in addition to causing developmental delays, exposure to ethanol during development may also cause early embryonic death. This study has the potential to provide support for those who try to warn mothers of the dangers of consuming alcohol during pregnancy.

C05
The Effect of Addition of a Marketed Energy Booster on the Growth Rate and Total Growth of Holstein Heifers

Presenter(s)
Grace Carlberg, Illinois Mathematics and Science Academy

Advisor(s)
Henry Hoene, University of Illinois at Urbana-Champaign

Increased corn prices and a boom in ethanol production increased livestock feed prices, prompting a move in the cattle industry from feedlots to grazing fields. Grazing cattle, though less costly, is less efficient in land use than placing cattle on feedlots. To prompt a movement back to the feedlots, a cost effective way must be found to produce better cattle, as to counteract the reduced price of grazing. It was hypothesized that an increased amount of rumen-inert fat in the diet of cattle could solve this problem. The effects of Energy Booster 100, a product made up of this fat, were tested. After a week-long acclimation period, Holstein heifers were treated with the additive; six weights were recorded for each. The average changes in weight of the control and experimental groups were compared with a paired t-test for assumed equal variances ($t=0.274$, $df=10$, $p=0.789$), the slopes of the growth rates were analyzed (test stat.$=0.615$, $df=5$, $p=0.561$) finding no significant difference in either category. Having no significant effect on the change in weight, the product was deemed ineffective in prompting the move from grazing-fields to feedlots. In a later study, different products at different concentrations could be tested for improved results.

C06
The Effects of Growing Method on the Crop Efficiency in Legume Grain Crops

Presenter(s)
Grace Carlberg, Illinois Mathematics and Science Academy
David Kodama, Illinois Mathematics and Science Academy

Advisor(s)
John Thurmond, Illinois Mathematics and Science Academy

The wave of urbanization in agriculture and the increasing human population requires food production to become more efficient. The use of hydroponic systems, more efficient in land area than field growth, has the potential to increase this efficiency; it is unknown whether crops or efficiency will be negatively affected. We examined the factors of water consumption, mass, and volume in crop efficiency through the comparison of hydroponically grown legume grain crops to those grown in a simulated field-grown system. The crop type and the growing method both significantly affected the wet mass ($p=0.0002$, $p= < 0.0001$). The dry mass test confirmed these results ($p= 0.0252$, $p=0.0026$). With respect to volume, plant type and growing method significantly affected wet mass ($p= < 0.0001$, $p= < 0.0001$), but the dry masses showed a marginal difference in crop type and a significant difference in growing method ($p=0.056$, $p=0.001$). With respect to water, crop type and growing method significantly affected the dry mass ($p= < 0.0001$, $p= < 0.0001$); the results of the wet mass test showed the same. Our analyses show that the growing method affects the crop efficiency with respect to mass and volume, though the effect with respect to water depended on the difference in mean mass of the soybeans.

C07
Effects of Antibiotics on Gastrointestinal Motility and Gut Microbiota

Presenter(s)
Catherine Chen, Illinois Mathematics and Science Academy

Advisor(s)
Eugene Chang, University of Chicago
Ketrija Touw, University of Chicago

Antibiotics are widely used to treat infectious diseases caused by pathogenic bacteria. While eliminating pathogens, antibiotics also affect gut commensal bacteria composition leading to long-lasting gastrointestinal (GI) symptoms associated with GI motility problems. In this study the mechanism by which the broad spectrum antibiotic Cefoperazone affects GI motility and gut microbial composition was examined. To assess alterations in the host after antibiotic treatment, whole gut transit time was measured by gavaging and tracing charcoal dye. Significantly delayed GI transit time in antibiotic-treated mice was observed. Bacterial community structure in cecal contents was analyzed by 16S rRNA analysis. Results showed significant decrease in Bacteroidetes and increase in Tenericutes in Cefoperazone-treated mice. Hydrogen sulfide levels in the stool samples increased in antibiotic-treated mice. Short chain fatty acids were measured and showed lower levels in antibiotic-treated mice. To determine antibiotic effects on the host, quantitative reverse transcription polymerase chain reaction and Western blot analysis were used, but no significant differences in the host proximal colon tissue were observed. Overall, these results suggest that Cefoperazone leads to delayed GI transit time due to alterations in microbial community and metabolic profile. These findings could be beneficial for alleviating symptoms associated with antibiotic usage.

C08
Modeling Herpes Simplex Virus Infection to Determine Antiviral Efficacy of Zinc Oxide Nanoparticles

Presenter(s)
Jason Chen, Illinois Mathematics and Science Academy
Angad Garg, Illinois Mathematics and Science Academy

Advisor(s)
Deepak Shukla, University of Illinois at Chicago

Herpes simplex virus-1 (HSV-1) is a prevalent virus affecting over 90% of the human population, though few people display symptomatic cold sores of the mouth and keratitis of the eye. During transmission of HSV-1, viral glycoproteins bind with heparan sulfate cell surface proteoglycans, facilitating endocytosis of viral particles. The presence of zinc oxide (ZnO) nanoparticles inhibits binding between virus and cell and thus virus transmission. We studied HSV-1 transmission *in vitro* using HeLa, VERO, and HCE cell lines both with and without ZnO present, measuring the number of infected cells over time via green fluorescent protein HSV-1. Using this empirical data, we created a mathematical model incorporating differential Lotka-Volterra equations and evaluated necessary parameters to create an accurate model. We analyzed how the addition of ZnO changed parameters such as transmissibility and removal rate to quantitatively determine the nanoparticle's impact. Transmissibility was found to decrease by more than half with the addition of ZnO while removal rate remained constant. However, the basic reproductive ratio R_0 was found to remain above one, signifying viral propagation would continue, although at a greatly reduced rate. Our findings quantify the effectiveness of ZnO nanoparticles at inhibiting transmission and curing infection of HSV-1.

C09
Early Oligomer Detection in Alzheimer’s Disease Using Intranasal Probes

Presenter(s)
Esther Chung, Illinois Mathematics and Science Academy

Advisor(s)
William Klein, Northwestern University
Kirsten Viola, Northwestern University

Alzheimer's disease (AD) detection probes are used for diagnosis. However, these probes target amyloid plaques, a protein that develops very late in pathogenesis. I experimented with novel probes, delivered intranasally, that targeted amyloid beta oligomers, a protein which develops earlier in pathogenesis. I compared the two different types of intranasal probes, one conjugated with an NU4 antibody and the other conjugated with an ACU-193 antibody. Mice of increasing ages were intranasally injected with either NU4 or ACU-193 and brains were sliced and probed for oligomer detection. The brain slices were then reprobed with the same antibody to determine contrasts between the amounts of oligomers that were delivered intranasally versus traditionally. Preliminary data suggest that there is no significant difference between the two methods, supporting the efficacy of the intranasal probe. After reprobing, the slices will also be probed using a Thio S counterstain that detects amyloid plaques. Because of the different target protein, it is not anticipated that a signal will be detected for younger animals. The amount of oligomers present in the brain will be quantified biochemically by both dot-blot and ultra-sensitive ERRENA-based assay. These data will be compared to the oligomer levels detected by histochemistry to determine if there is a correlation. The success of these probes could allow for earlier AD diagnosis.

C10
Investigating Nanoluciferase as a Potential Proteome Stress Sensor

Presenter(s)
Heidi Dong, Illinois Mathematics and Science Academy
Sarah Xu, Illinois Mathematics and Science Academy

Advisor(s)
Sue Fox, Northwestern University
Richard Morimoto, Northwestern University
Anan Yu, Northwestern University

Firefly luciferase (Fluc) is a well-documented proteosome sensor that oxidizes the photon-emitting substrate luciferin to produce bioluminescence. However, its drawbacks are namely its large size (63 kDa) and dependence on adenosine triphosphate (ATP) for catalytic activity. Since stresses to the cell can affect ATP production, Fluc activity is not solely dependent on its proper folding. Our project aims to examine a luciferase synthesized from deep sea shrimp, nanoluciferase (NanoLuc), which is smaller (19 kDa) and more luminescent than Fluc as well as ATP-independent. This will help determine if it can accurately detect proteome stress from both internal and external stress. We used four forms of NanoLuc: wild type, 8M, R116N, and 8M+R116N, with each successive mutant more unstabilized. We expressed the proteins in *Escherichia coli* and cloned the genes into mammalian cells to examine how precisely NanoLuc detects chronic and acute stress. We also purified the NanoLuc protein in the transformed *E. coli* in order to find folding conditions necessary for the protein. Preliminary results show that NanoLuc can detect stress levels *in vitro* for human neuroblastoma cells, as two hour heat stress led to aggregation of the protein. This suggests that NanoLuc does indeed behave like a proteosome stress sensor, which supports our hypothesis.

C11
The Effect of Omega-3 and Omega-6 Fatty Acids on the Expression of ERK and AKT in Human Pancreatic Cells

Presenter(s)
Chase Engelbrecht, Illinois Mathematics and Science Academy

Advisor(s)
Paul Grippo, University of Illinois at Chicago

Extracellular signal-related kinase and AKT, a serine/threonine kinase, have been linked to the worsening of several cancers. Studies have shown that polyunsaturated fatty acids may have an effect on the expression of these kinases, and as a result, an effect on the formation of cancer. Three types of pancreatic cells were cultured (HPDE, HPDE-Kras, and Pancl) and treated with bovine serum albumin. The experiment consisted of a control group, a group treated with omega-3 fatty acids, and a group treated with omega-6 fatty acids. mRNA from these cells were isolated and converted to cDNA with reverse transcription polymerase chain reaction (PCR) and subsequent quantitative real-time PCR. Results for this data continue to be processed. Initial findings demonstrated that the introduction of omega fatty acids does not have any significant effect on the production of ERK while omega-3 fatty acids reduce and omega-6 fatty acids enhance mRNA levels of AKT. This data is plausible, as other findings in our lab demonstrate a direct correlation between these fatty acids and AKT, not ERK. Hence, my data corroborates these results and provides the rationale for future studies looking at the mechanism(s) by which these acids regulate control of AKT and its expression. The ultimate goal would be to extend this to suggest a modification in diet as a preventive treatment for pancreatic cancer.

C12
Effects of the Micro Ribonucleic Acid miRNA-122-5p on MCF-7 Cell Proliferation

Presenter(s)
Nisa Faheem, Illinois Mathematics and Science Academy
Rajiv Trehan, Illinois Mathematics and Science Academy

Advisor(s)
C. Robyn Fischer, Illinois Mathematics and Science Academy

Micro ribonucleic acid (microRNA), a small non-coding RNA, has the potential to intercept messenger RNA and prevent cellular messages from being sent. A certain type of microRNA, miRNA-122-5p, has been shown to play a role in the rate of proliferation of various carcinomas. We investigated the possible correlation between the introduction of the miRNA and cell growth by examining which pathway/protein the miRNA specifically interferes with. We first transfected the miRNA into the MCF-7 breast adenocarcinoma cell line and grew these cells in the same conditions as untransfected cells. The second stage involved looking at Akt (protein kinase B) expression levels; Akt is a critical factor within the cell proliferation pathway. We used Western blot data on various dilutions of unaltered cell protein extracts to estimate the needed concentration for phosphorylated Akt detection. Based on these tests, we found that undiluted cell samples provide the most viable Akt expression data. Currently, we are conducting Western blot tests on transfected cells and unaltered cells in order to see if there is a difference between Akt expression levels. If our tests are successful, then we will be able to understand miRNA-122-5p's function within the Akt cellular pathway and cell proliferation.

C13
Deoxycholic Acid Alters DNA Methylation in Caco2BBE Cells

Presenter(s)
Yan Lin Feng, Illinois Mathematics and Science Academy

Advisor(s)
Eugene Chang, University of Chicago
Kyle Dolan, University of Chicago

Studies have shown that high levels of the bacterial metabolite deoxycholic acid (DCA) in the gut promote colon cancer progression. Although DCA is known to influence proliferation and apoptosis, its mechanism of action is still poorly understood. Because aberrant DNA methylation can drive cancer development, we hypothesize that this epigenetic marker is involved in DCA-induced cancer progression. We assessed the effects of DCA on the expression of DNA methylation enzymes and DNA methylation content in the colon cancer cell line, Caco2BBE. Cells were treated with varying concentrations (10-300 μM) of DCA. Gene expression and methylation content were determined by quantitative polymerase chain reaction (PCR), methylation specific PCR, and enzyme-linked immunosorbent assay. The expression of DNA methyltransferases (DNMTs) 1, 3a, and 3b decreased with DCA treatments. With 10 μM treatments, Caco cells exhibited a greater than two-fold increase in 5-methylcytosine content. At higher concentrations of DCA, 5-mC content appeared to remain unchanged. These findings suggest that bile acids alter DNA methylation in Caco2BBE cells.

C14
Variations of the Cytochrome P450 Messenger RNA in *Schistosoma mansoni*

Presenter(s)
Ethan Fisher, Illinois Mathematics and Science Academy

Advisor(s)
David Williams, Rush University
Peter Ziniel, Rush University

The parasitic flatworm *Schistosoma mansoni* afflicts many people in Third World countries and is a major agent of schistosomiasis. This disease is known to cause hepatosplenomegaly, abdominal pain, and even reduced productivity levels and ability to learn, among other symptoms. Currently, the sole treatment for this disease is praziquantel. Since praziquantel has its limitations, the cytochrome P450 in *S. mansoni* has been suggested as a potential new drug target. To determine if variation existed in P450, the mRNA of cytochrome P450 had been reverse transcribed into cDNA, subjected to polymerase chain reaction, cloned, and then sequenced and analyzed. Six variations on this gene were found in ten samples, even when a proofreading polymerase was used. This suggested that the mRNA of the P450 protein might undergo variation and vary between populations of worms or within individual worms. DNA samples from a large number of DNA sequences from different sexes of worms in different stages of the *S. mansoni* life cycle went through the same process used in the original experiment. Despite the original experiment, results indicate that variation does not exist in *S. mansoni* at all. The lack of variation would make cytochrome P450 an easier drug target.

C15
Halting Herpes Simplex Virus Cell-to-Cell Fusion With Zinc Oxide Nanoparticles

Presenter(s)
Cammille Go, Illinois Mathematics and Science Academy

Advisor(s)
Deepak Shukla, University of Illinois at Chicago

Herpes simplex virus' ability to spread through cell-to-cell fusion enables it to avoid the host's immune system. As a result, it is one of the most prevalent human pathogens, infecting the majority of adults. Cells were treated with either ultraviolet-treated zinc oxide (UV ZnO) or zinc oxide (NUV ZnO) at a concentration of 0.1 mg/ml. As part of the cell-to-cell fusion assay, target cells expressing the viral entry receptor and a green fluorescent protein, and effector cells transiently over-expressing the viral genes of interest, and a red fluorescent protein, were mixed together in a 1:1 ratio. The major challenge faced was determining what ratio of plasmids to transfect the genes with. Results demonstrate that the formation of syncytia was significantly less in cells that had been treated with either UV ZnO or NUV ZnO. Wells that had received the mock treatment of phosphate buffered saline displayed significantly more cells that either fluoresced both red and green or that had three or more nuclei per cell after being treated with Giemsa stain. Zinc oxide appears to have significant prophylactic effects and may have potential as an antiviral drug. By reducing cell-to-cell fusion it significantly reduces the ability of HSV to proliferate.

C16
Functional Response of *Toxorhynchites rutilus* to Prey Density and the Effects of Container Size

Presenter(s)
Jonah Goughnour, Illinois Mathematics and Science Academy

Advisor(s)
Steven Juliano, Illinois State University
Geoff Ower, Illinois State University

The functional response is the relationship between the average number of prey eaten by each predator per unit time and prey density. Data from the functional response can be used to predict the number of prey a predator may eat under a given set of conditions. We measured the effect of the size of a water-filled container on the functional response of an aquatic predator to prey density. The predation of *Toxorynchites rutilus rutilus* larvae upon larvae of *Culex spp.* under standard laboratory conditions was quantified in two containers which differed in volume by a factor of 15. Each container had similar *Culex spp.* prey per liter. The relationship between the number of prey eaten and the original density were analyzed by fitting nonlinear curves, and testing multiple models postulating differences in functional response parameters. Models were compared using Akaike information criterion and parameters tested for significant differences between container sizes. We found that the container size significantly affects the functional response of the *T. rutilus*, specifically the handling time of the predator. We hypothesize that the decrease in handling time in larger containers resulted from less thorough digestion of the prey, or an increased use of energy required for moving around a larger area to search for prey.

C17
Determining the Localization of *Allobaculum* Species E14 in the Mouse Intestine Using Fluorescence *in Situ* Hybridization

Presenter(s)
Binita Gupta, Illinois Mathematics and Science Academy

Advisor(s)
Eugene Chang, University of Chicago
Daina Ringus, University of Chicago

The human gut microbiome houses trillions of microorganisms that are vital to digestion and human health, though many of the specific functions of these microbiota remain unknown. One taxon of bacteria frequently found in the gastrointestinal tract of experimental C57B/6 mice are *Allobaculum* species (spp.) though very little is known about these Gram-positive bacteria. In order to better understand its niche in the intestinal microbial community, we sought to determine the location of a novel, mouse-specific *Allobaculum* (sp. E14) bacterium in the mouse gut. The methodology of fluorescence *in situ* hybridization (FISH) allows us to specifically label and enumerate bacteria in multiple species environments. We optimized the FISH protocol using *Allobaculum* spp. E14 in pure culture, mixed communities (e.g. stool), and fixed sections of mouse intestine. Cross sections of the intestine were fixed using Carnoy's Solution to preserve the integrity of the mucus layer. *Allobaculum* spp. were detected in sections by labeling with a fluorescently tagged oligonucleotide specific for the 16S gene in *Allobaculum* sp. E14 and visualizing under a confocal fluorescence microscope. In the fixed sections, *Allobaculum* sp. was detected in the ileum, the proximal, and the distal colon, indicating localization throughout the entire mouse intestine.

C18
The Effect of Chronic, Low Levels of Phenol on the Aging of *Drosophila melanogaster*

Presenter(s)
Leehwa Hong, Illinois Mathematics and Science Academy

Advisor(s)
Vandana Chinwalla, Illinois Mathematics and Science Academy

Today’s global population is constantly challenged by environmental pollutants, specifically in the aspects of neurological stress and aging. One such pollutant is phenol, a chemical found in low levels in air and soil as a result of industrial waste. While in large quantities acute phenol poisoning induces organ damage in humans, the consequences of low levels of phenol is unknown. By using the fruit fly, *Drosophila melanogaster,* as a toxicology model, I examined the effects of chronic levels of phenol on its aging and associated stress. Preliminary results indicate that *Drosophila* exposed to 0.1% phenol exhibit delayed development in hatching, as well as a shorter lifespan. Data on aging and stress was also collected via negative geotaxis assays and analyzed through a two-sample t-test. Results indicate that although control and treatment groups did not display differences in negative geotaxis in the first week of emergence, treatment flies displayed significantly lower locomotive responses two weeks following emergence, suggesting the group’s early aging. Thus, preliminary results of longevity and geotaxis assays indicate that low levels of phenol compresses lifespan. Understanding the chronic exposure of environmental toxins on living beings can be a significant factor in creating policies that consciously minimize industrial waste emissions.

C19
The Effects of Caffeine and Taurine on Learning and Locomotion in *Drosophila melanogaster*

Presenter(s)
Nicholas Inocencio, Illinois Mathematics and Science Academy

Advisor(s)
Vandana Chinwalla, Illinois Mathematics and Science Academy

Red Bull GmbH and other energy drink companies claim that their products help consumers focus on athletics, work, and studies. Caffeine and taurine are the most common ingredients found in the energy drinks which have been shown to modulate sleep; a low taurine to caffeine ratio modulates sleep more compared to caffeine alone. This study looks at the effect of caffeine, taurine, and the combination found in Red Bull on learning and memory in the fruit fly, *Drosophila melanogaster*. The flies were allowed to feed on each substrate for 48 hours and then tested using Pavlovian olfactory conditioning paradigm using a T-maze. Their locomotion was tested using negative geotaxis, and a larval learning assay was carried out using the odor- taste appetitive learning assay. Preliminary results suggest that larvae exposed to caffeine alone do not learn as well during larval learning assays when compared to the control group. T-maze assays show that caffeine negatively affects learning, while taurine and Red Bull do not. Caffeine-fed flies show decreased locomotion compared to the control group, taurine, and Red Bull fed flies. Caffeine alone seems to be detrimental to overall performance in flies, but exposure to taurine, even in conjunction with caffeine, seems to improve learning.

C20
HIV-1 Expression Profiling by High Throughput Sequencing on *in Vitro* Infected CD4+ T Cells

Presenter(s)
Vivian Jin, Illinois Mathematics and Science Academy

Advisor(s)
Eunyoung Kim, Northwestern University

Human immunodeficiency virus type-1 (HIV-1) infection of CD4+ T cells establishes a virus-host system where the virus interacts with the cellular machinery to evade antiviral responses while the host tries to fight the infection. This project aims to quantify and profile HIV transcripts utilizing RNA sequencing data obtained from *in vitro* infected CD4+ T cells from five healthy donors at various type points and generate a virus-host interaction network out of the host transcriptional profiling from the same RNA sequencing experiment. Due to the novelty of this approach, we compared several transcript quantification methods and selected the most closely related to the overall HIV RNA levels. The method selected was a transcript reference based alignment and quantification using RSEM software. Once we had a reliable quantification of the HIV transcripts through time, we correlated them with host transcriptional profiles. Using this guilt by association approach, we were able to generate a virus-host network in which we detected the pathways most likely to be affected by HIV-1 regulatory proteins. These pathways included regulation of transcription, metabolic processes, and signal transduction among others. As a result of this experiment we have gained insight on viral- host cellular interactions using a novel method of HIV-1 transcript quantification.

C21
Classification of Breast Cancer into Molecular Subtypes and the Role of Ki-67 Protein in Tumor Progression

Presenter(s)
Chinyere Kemet, Illinois Mathematics and Science Academy
Stefanie Ochoa, Illinois Mathematics and Science Academy

Advisor(s)
Galina Khramtsova, University of Chicago
Olufunmilayo Olopade, University of Chicago
Elisabeth Sveen, University of Chicago

As of January 2014, breast cancer affected 41% (3,131,440) of US individuals. Ki-67 is actively expressed in cells that are going through division. The goal of this investigation was to compare Ki-67 expression within different breast cancer subtypes with varying degrees of aggressiveness. Luminal A is the least aggressive while HER2+ and basal-like tend to be the most aggressive subtypes. The Dako Hercep and Allred scoring systems were used to classify 172 patient breast tissue samples into different breast cancer subtypes. These cases were then analyzed using ImmunoRatio and manual scoring to determine the gene expression of Ki-67. It was found that 103 samples were classified as Luminal A, 36 as Basal-like, 15 as HER 2+, and 18 as Luminal B. When comparing the data of Ki-67 protein between the subtypes, there is a significant difference between all subtypes. With this data it can be concluded that the more aggressive a breast cancer subtype is, the more prevalent is expression of Ki-67.

C22
I Spy: A Functional Magnetic Resonance Imaging Study of Hippocampal Activation During a Spatial Memory Task

Presenter(s)
Vedhik Kodavatiganti, Illinois Mathematics and Science Academy
Shveta Thakkar, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University

This investigation endeavored to create a spatial/object memory task for a single subject functional magnetic resonance imaging (fMRI). The goal of the task was to activate the anterior hippocampus and other areas of the brain associated with spatial/object memory on a single subject level for pre-surgical mapping in epilepsy. Five subjects were given the spatial/object memory task. Images from various hidden object games online were found and specific objects were isolated. During the task the subjects were shown two objects (the encoding block), an intensity discrimination task (the control block), and then the two images from where the objects originated (the retrieval block). Each block was twenty seconds long and there were twelve iterations. The fMRI data was processed on the Northwestern University Neuroimaging Data Archive and visualized through Multi-image Analysis Graphical User Interface. Activations were found predominantly in the occipital lobe but not found in the hippocampus. Therefore, the task would not be effective for pre-surgical mapping in epilepsy.

C23
Mechanisms of WDR5- and PKN1-Driven Growth in Prostate Cancer

Presenter(s)
Sanjay Kottapalli, Illinois Mathematics and Science Academy

Advisor(s)
Debabrata Chakravarti, Northwestern University
Jiyoung Kim, Northwestern University

Long the standard of treatment for prostate cancer (PCa), androgen- deprivation therapy (ADT) retards the growth of PCa cells by systemically depleting the androgen hormones they require to proliferate. However, due to selection pressures, the disease eventually progresses to a form termed castrate-resistant prostate cancer (CRPC), which is able to grow in the absence of androgen and is ultimately responsible for most deaths related to PCa. Both hormone responsive and castrate resistant prostate cancer need to be better understood at the molecular level for future therapeutics. In this study, we attempted to characterize the roles of proteins WDR5 and PKN1 in gene regulation and cell proliferation in PCa. Western blots of PCa cell lines revealed that WDR5 and PKN1 are found in high proportions in the nucleus and on chromatin. AlamarBlue proliferation assays found that knockdown of either WDR5 or PKN1 results in a significant decrease in cell proliferation, and reverse transcription quantitative polymerase chain reaction experiments found the same for WDR5 and PKN1 with respect to androgen receptor target genes. We conclude that PKN1 and WDR5 are critical for PCa function and that they present possible targets for future therapeutic development.

C24
Genetic Comparison of Various Nitric Oxide-Adapted Cancer Cells Using *in Silico* Techniques

Presenter(s)
Niresh Kuganeswaran, Illinois Mathematics and Science Academy

Advisor(s)
James Radosevich, University of Illinois at Chicago

Over-expression of the free radical nitric oxide (NO) is a hallmark of all human tumors. It is believed to be important in promoting angiogenesis and tumor progression. According to the generally accepted cancer stem cell theory, some tumor cells act as stem cells, reproducing other tumor stem cells, as well as the less aggressive tumor cells. One alternative hypothesis has been that cancer stem cells are actually results of the adaptation of cancer cells to high NO levels. We replicated this adaptive process exposing ten different types of cancers to high levels of NO. Using gene chip analysis, the genetics of the cancers before and after the adaptation were observed. With a computer program coded in the Java language, we were able to determine three commonly up-regulated genes among all of the cell lines: *COX7*, *CORO1B*, and *PSMA7*. In addition we found that the genes *PDHA1*, *RP6-159A1.2*, *RBMX*, *RP11-255N24.3*, and *RBMXP1* were commonly down- regulated in these ten cell lines. Preliminary research suggests that these changes in gene regulation are responsible for the creation of tumor stem cells further challenging the cancer stem cell theory.

C25

The Effects Food and Olfactory Enrichments Have on the Activity Time of the Grey Wolf, *Canis lupus*

Presenter(s)
Sarah Leahy, Illinois Mathematics and Science Academy

Advisor(s)
C. Robyn Fischer, Illinois Mathematics and Science Academy
Randy Johnson, Phillips Park Zoo

Enrichments are used by zoos to engage natural wild behaviors, such as foraging, primarily to decrease stereotypies, harmful behaviors indicating signs of boredom or depression, and increase physical activity in captive animals. My proposed research was studying the effects of enrichment on the physical activity levels of grey wolves, *Canis lupus*. The purpose was to see if food and olfactory enrichments increased, decreased, or kept the activity level the same in two wolves at the Phillips Park Zoo. I observed the wolves before and after enrichment or feeding and recorded the time they spent being active and inactive. The wolves were fed once a week and received enrichment activity once in two weeks. I analyzed the amount of time in which they are active and non-active to see if there is a significant difference between the times during the weeks they received enrichment as compared to the weeks when they did not. There was a significant difference between weeks, with a P-value of less than 0.0001; the wolves showed to be significantly less active on the days where they received enrichment, meaning that enrichment decreased activity.

C26

Toll-Like Receptor-Induced Cytokine Production by Macrophage Cells in Response to Bacteria Exposure

Presenter(s)
Monica Mastrud, Illinois Mathematics and Science Academy

Advisor(s)
C. Robyn Fischer, Illinois Mathematics and Science Academy

Toll-like receptors (TLRs) are a part of the innate immune system, which is the first response system activated when pathogens invade the body. TLRs are found on cells of the immune system, such as macrophages, and respond to pathogen associated molecular patterns. U937 monocyte cells were differentiated into macrophages by exposure to phorbol 12-myristate 13-acetate. The amount of tumor necrosis factor alpha and interleukin 6 cytokines that were produced by cells in response to a variety of both Gram-positive and Gram-negative bacteria was analyzed using Western blotting. It is expected that exposure to Gram-positive and Gram-negative bacteria will produce different amounts of cytokines. Additionally, results from Gram-positive bacteria were compared to other Gram-positive bacteria, and results from Gram-negative bacteria were compared to other Gram-negative bacteria, in order to determine how the cytokine production varied within one classification of bacteria. Results will be shared at the presentation.

C27
Anatomy and Biomechanics of the Feeding Behavior of the Alligator Gar, *Atractosteus spatula*

Presenter(s)
Samantha Medina, Illinois Mathematics and Science Academy

Advisor(s)
Justin Lemberg, University of Chicago
Mark Westneat, University of Chicago

Although alligator gars are one of the largest freshwater fish species in North America, the behavior and mechanics of their feeding behavior remains largely unknown. In order to better understand the biomechanics of gar feeding behavior, the jaw anatomy of several gar species [alligator gar, long nose gar (*Lepisosteus osseus*), and short nose gar (*Lepisosteus platostomus*)] were studied and analyzed using the biomechanical software package MandibLever. To analyze the alligator gar's feeding behavior and the motion of the jaw, high speed videos were taken while they fed and the motion of multiple points on their jaws was plotted and graphed in the digitizing application StereoMorph. Results show that gar species rely on a combination of bite force and suction to feed. Bite forces vary widely across gars, with differences in bite forces between long nose and alligator gars indicating that jaw length and width affects bite force. Analysis of high speed video suggests that the upper jaw of gars may be more flexible than previously thought. Biomechanical analysis of feeding in top predators such as gars increases our understanding of food webs and predator prey relationships in complicated freshwater ecosystems.

C28
Assessing Opioid-Induced Hyperalgesia in Temperature Tests With Patients Diagnosed With Chronic Low Back Pain

Presenter(s)
Arthur Ortiz, Illinois Mathematics and Science Academy

Advisor(s)
Sara Connolly, Rehabilitation Institute of Chicago
R. Norman Harden, Rehabilitation Institute of Chicago
Alexandre Khoury, Rehabilitation Institute of Chicago
Amy Kirsling, Rehabilitation Institute of Chicago

Opioids are commonly used to treat patients with chronic pain, however it is hypothesized that they cause a phenomenon called opioid-induced hyperalgesia (OIH). OIH is a condition of nociceptive sensitization, or abnormal pain sensitivity, caused by exposure to opioids. This study examined the effect of opioid usage on pain felt from temperature and temperature perception in patients with chronic low back pain. These factors were assessed using quantitative sensory testing (QST) which included the warm and cold sensation tests, the heat-induced pain test, and the cold-induced pain test. This study compared these tests between two groups: patients experiencing back pain not taking opioids and patients experiencing back pain taking high dose opioids. Although there was some variation between the data of both groups, the differences were not significant. The difference in data between patients with chronic back pain taking no opioids and those taking high dose opioids was not significant, thus showing no relationship between opioid dosage and pain sensitivity in terms of temperature. However, more data needs to be collected to provide definitive results.

C29
Hepatic XBP-1s Regulation and Response to Deoxycholic Acid and Cholic Acid Feeding to Mice

Presenter(s)
Seong Park, Illinois Mathematics and Science Academy

Advisor(s)
Richard Green, Northwestern University

When unfolded or misfolded proteins are misfolded, endoplasmic reticulum (ER) stress can occur, resulting in cholestatic liver diseases and inflammation. To protect liver cells from ER stress, unfolded protein response (UPR) signaling pathways are activated including the inositol-requiring enzyme (IRE1)/X-box binding protein 1 (XBP-1) signaling pathway. Feeding bile salts to mice is a standard model of liver injury and we determined the effect of feeding the bile salts deoxycholic acid (DCA) and cholic acid (CA) on UPR target genes in XBP-1 and other pathways in mice. Real-time quantitative reverse transcriptase polymerase chain reaction was used to measure UPR target gene expressions (XBP-1s, EDEM, ERdj4, BIP, ATF4, ATF6, CHOP) in the livers of FVB- mice fed with DCA and CA. Deoxycholic acid and cholic acid feeding increased hepatic gene expression of XBP-1 spliced (XBP1s) and its downstream target gene ERdj-4, whereas no significant effect was found in ATF4, ATF6, CHOP, EDEM, and BIP gene expression. Compared to CA, DCA caused a greater effect on these UPR target gene. Understanding the effects of the different bile acids on each UPR target gene may provide better understanding in the roles of each UPR target gene in protecting the liver from bile salt injury.

C30
The Effect of Methionine-Choline Deficient Diet on Hepatic Inflammations and Liver Injuries in Phosphatidylethanolamine N-Methyltransferase Deficient Mice

Presenter(s)
Seong Park, Illinois Mathematics and Science Academy

Advisor(s)
Richard Green, Northwestern University

In liver, phosphatidylcholines (PC) play many important roles including serving as a structural component of cell membranes and regulating lipid secretion into bile. PC is synthesized in the liver either by the cytidine diphosphate- choline (CDP-choline) pathway or the phosphatidylethanolamine N-methyltransferase (PEMT) pathway. The CDP-choline pathway requires the essential nutrient choline in order to synthesize PC. A choline-deficient diet therefore causes fatal liver damage in PEMT knockout mice, since this latter backup synthetic pathway is not present. In this investigation, mice were fed a methionine-choline deficient (MCD) diet to activate the endoplasmic reticulum stress response to liver cell injury. The role of the MCD diet in mice with reduced PEMT is currently unknown. Male PEMT (+/-) and PEMT (+/+) mice were fed either an MCD diet or chow for 14 days. Real-time quantitative reverse transcription polymerase chain reaction was performed on mouse livers to determine the effect of MCD diet on the gene expression of unfolded protein response (UPR) target genes in PEMT (+/+) and PEMT (+/-) mice. MCD diet-fed PEMT (+/-) mice showed an increasing trend in hepatic gene expression of XBP-1s, ERdj4, and TNF1a, whereas no significant effect was found in EDEM, XBP1u, and IRE-1a gene expression. The trends will be further investigated with additional experiments.

C31

Distribution of Mutated Yet Functional Pro-Apoptotic Protein BaxΔ2 in Human Organs and Tissues

Presenter(s)
Kyle Parker, Illinois Mathematics and Science Academy

Advisor(s)
Adriana Mañas, Illinois Institute of Technology
Jialing Xiang, Illinois Institute of Technology

Apoptosis, or programmed cell death, removes cancerous cells from the body and is facilitated by Bcl-2 genes such as Bax. Mutations on the Bax gene can lead to the formation of an isoform of the apoptotic-inducing protein Baxα called BaxΔ2, a protein that is both functional and promotes selective sensitivity to chemotherapy drugs. In this investigation, we analyzed the distribution of BaxΔ2 in organs and tissues of the human body by screening tissue microarrays. Each core was given a score from 0 to 3 for positivity of BaxΔ2. Normal-adjacent tissue was typically more positive than tumor tissue, and well-differentiated tumor tissue was more positive than poorly- differentiated tumor tissue. The stomach, colon, bladder, and endometrium were the most positive organs while the prostate, ovaries, and breasts were the least. A two-way ANOVA was conducted. The results showed that there was a statistically significant influence of organ ($p = .001$) and tissue ($p < .001$) on positivity, as well as a statistically significant interaction between organ and tissue ($p < .001$). Knowing the distribution of BaxΔ2 allows us to better understand when and why it forms, which brings us closer to fully exploiting its potential as a prognostic biomarker for cancer treatment.

C32
Investigating the Impact of Bacteria on Gene Expression in Germ-Free and Specific-Pathogen-Free Enteroids and Colonoids

Presenter(s)
Mit Patel, Illinois Mathematics and Science Academy

Advisor(s)
Candace Cham, University of Chicago
Eugene Chang, University of Chicago

Commensal bacteria that are normally present in the intestine of mice aid in the digestion of food and also provide essential nutrients to the host. Germ-free (GF) mice lack intestinal bacteria and exhibit phenotypic differences from mice that do have intestinal bacteria (specific-pathogen-free, SPF). We observed that while intestinal organoids isolated from SPF mice can be maintained for more than 6 months in culture, intestinal organoids isolated from GF mice last only for approximately 3 months. Therefore, we hypothesized that the presence of bacteria influences the proliferation and/or differentiation potential of intestinal stem cells by inducing expression of genes involved in these pathways. We isolated organoids from the ileum (small intestine) and colon (large intestine) from GF and SPF wild-type mice and maintained them in culture for 1 month. We added stool lysates containing bacterial products from SPF mice to these organoids for 24 hours. We analyzed gene expression of GAPDH, OLFM4, ASLC2, SPDEF, TCF4, HES1, LGR5, and WNT3A by performing quantitative reverse transcription polymerase chain reaction. These genes were chosen because they are involved in the development of the intestine. Further studies are needed to understand the role of bacteria in intestinal development.

C33
Exploration of Acetyl-CoA Carboxylase to Develop Fungicides for Agriculture

Presenter(s)
Samuel Qian, Illinois Mathematics and Science Academy

Advisor(s)
Piotr Gornicki, University of Chicago
Robert Haselkorn, University of Chicago

In recent years, a wheat rust disease has resulted in millions of dollars of losses in wheat crops. Other fungal diseases are also causing serious problems. The long-term objective of the project is to develop new fungicides targeting acetyl-CoA carboxylase (ACC). The goal of the project was to express fungal ACCs in insect sf9 cells, so that a system could be set-up to test *in vitro* compounds that inhibit the activity of fungal ACCs. ACC from three fungi were worked on in parallel. A plasmid DNA vector was containing a fungal ACC gene assembled and then replicated in *E. coli*. Then, the plasmid was purified from *E. coli*, and recombined the ACC gene into the baculovirus genome (bacmid). This was done by transformation of the ACC containing plasmid to *E. coli* strain DH10Bac carrying the bacmid. Transfection of insect sf9 cells with recombinant bacmid isolated from *E. coli* produced baculovirus (P0) stock with the ACC gene in its genome. Infection of the insect sf9 cells was used to produce viral stock P1, which in turn was used to infect insect sf9 cells to express ACC. Preliminary results suggest that the enzyme ACC can be expressed in insect sf9 cells.

C34
Identifying Candidate Genes and Pathways in Autism

Presenter(s)
Naren Radhakrishnan, Illinois Mathematics and Science Academy

Advisor(s)
Martin Forde, University of Chicago

In this investigation, we aimed to identify and reclassify autism candidate genes as known risk factors or causes of autism. Autism has been classified as a neuropsychiatric disorder, but still lacks sufficient research. By identifying candidate genes that are closely related to known risk factors, we will learn more about the cellular processes in autism. Ingenuity Pathway Analyses (IPA), gene ontology (GO) analyses, and sequencing analyses were utilized. First, using IPA, candidate genes were mapped against known risk factors in order to identify those that were most closely related to these risk factors. Then GO analyses on the candidate genes were conducted to retrieve descriptive terms on the genes' roles in the cell. Finally, sequencing analyses were conducted on trios of autistic individuals (cases) and their two parents through alignment to compare the two groups. This sequencing produced a list of unique, significant mutations found in the cases. While the study did not provide enough information to completely reclassify any of these candidate genes as a known risk factor, it does offer interesting information on many of these candidate genes and their possible roles in autistic processes within the cell. We isolated the most significant candidate genes and learned more about their relation to autism. We also identified significant *de novo* mutations shared among cases and learned which of our candidate genes contained these alterations.

C35
Comparative Analysis of Vaccination Reactions in Dogs

Presenter(s)
Maureen Reiser, Illinois Mathematics and Science Academy

Advisor(s)
Helen Dane, Danada Veterinary Hospital
Sarah Johnson, Danada Veterinary Hospital

By law, all dogs must be vaccinated against rabies. Additionally, there are certain other diseases that dogs are strongly encouraged to be vaccinated against. Vaccines stimulate the immune system and can cause an adverse reaction such as facial swelling, vomiting, hives, and lethargy. There is no way to know in advance if a dog will have a reaction. The focus of my research was to identify correlations of adverse reactions to nine common vaccines given to dogs. Danada Veterinary Hospital has tracked adverse reaction information for the past seven years. I determined the most common reaction for each vaccine and any significant correlation between types of side effects and combination of vaccines. Through correlation analyses and descriptive statistics, preliminary results suggest that certain types of adverse reactions seem to be associated with specific vaccines or combinations of vaccines. If there is a significant likelihood of a reaction to a particular vaccination, the owner can be alerted to monitor for a reaction and veterinarians could pretreat and often prevent the reaction from occurring in future visits.

C36
The Effects of Deleting Foxo1 in the Pituitary of Mice at Embryonic Day 14.5

Presenter(s)
Megan Smiley, Illinois Mathematics and Science Academy

Advisor(s)
Buffy Ellsworth, Southern Illinois University at Carbondale

Foxo1 is a transcription factor that has been shown to regulate the differentiation of embryonic cells by reducing the number of cells that are preparing to divide. Pituitaries were examined because they control many hormones. It was not known whether *foxo1* had this effect at embryonic day 14.5 in mice. In order to determine this I examined littermate pairs where one was mutant and one was wild type. The mice had been injected with BrdU two hours before they were euthanized. I stained for BrdU in the mice that had been injected. I then photographed the pituitaries and counted the number of proliferating cells. The results of a two-tailed t-test showed that there was no significant difference between the number of proliferating cells in the pituitaries of the mutant and wild type mice. I also did a hematoxylin and eosin stain to determine what the overall pituitaries looked like. This means that at this age, *foxo1* does not play a role in the differentiation of the cells in the pituitary. At older ages, it decreases the number of proliferating cells, but at this age is may be more important for the pituitary to grow.

C37
Modeling the Interaction Between Insulin and Insulin-Degrading Enzyme: A Molecular Dynamics Simulation Study

Presenter(s)
Ranjani Sundar, Illinois Mathematics and Science Academy

Advisor(s)
R. Stephen Berry, University of Chicago
Esmael Haddadian, University of Chicago

The insulin-degrading enzyme (IDE) is involved in clearance of insulin, a protein vital for glucose homeostasis. To effectively cleave and deactivate insulin, IDE changes conformation to encapsulate the target substrate and split it in half. Diabetic patients have low insulin levels, which may be caused by the over activity of IDE. By understanding the mechanism of insulin's cleavage, we can better prevent over activity of IDE in degradation of insulin. To elucidate this interaction at the atomic level, we built a computational model of insulin encapsulated in IDE starting from each protein's crystalline structure (Protein-Database ID: 2WBY). To create this model, the Visualizing Molecular Dynamics software was used. Our completed model including the protein, water molecules, and ions consists of 90,275 atoms. Dynamics of the system were modeled using molecular dynamics simulations through analysis tools in the NAMD program. In this technique, the forces on all atoms in the system are periodically calculated and the motion of the atoms is determined by solving Newton's second law of motion. Scripts (such as root-mean square deviation) were run using the Beagle supercomputer at the University of Chicago. The applications of this model may help pharmacists design efficient diabetic treatments that inhibit activity of IDE.

C38
The Effects of A4VSOD1 Mutant Protein Incorporation on Calcium Ion Membrane Conductance

Presenter(s)
Shelly Teng, Illinois Mathematics and Science Academy

Advisor(s)
Michael Allen, University of Chicago
Ana Correa, University of Chicago
Jacob Riehm, University of Chicago

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease, characterized by a progressive loss of control in the motor neuron system that can often result in muscle weakness and paralysis. One possible cause of the familial form of ALS results from mutations in the Cu/Zn superoxide dismutase 1 (SOD1) gene. This point mutation leads to the A4V SOD1 mutant protein and the aggregation of the protein causes its incorporation into the lipid bilayer. This then has the ability to create ion-conducive pores. In this investigation, a computer-based system was used to control the voltage across an artificial lipid membrane. The quantitative difference between current levels indicated protein-induced ion conductance perturbations and changes in transmembrane ion flow. We then analyzed the data for a control and a test group to determine the effects of the A4VSOD1 mutant protein in its ability to create pores that can conduct calcium. Results suggest that A4VSOD1 allows higher calcium conductance and more events of current jumps in the membrane. From this, we concluded that the A4VSOD1 mutation causes greater toxicity by promoting lipid bilayer instability through its own incorporation into the membrane and may lead to cell death by interfering with calcium ion concentrations.

C39
The Effect of Parental Age on Mental Capabilities in Children

Presenter(s)
Andy Xu, Illinois Mathematics and Science Academy

Advisor(s)
Huayun Chen, University of Illinois at Chicago
Chunyu Liu, University of Illinois at Chicago

For the past few decades, the average age of parenthood as increased an average of three years. It has been reported that there is a link between increasing parental age and negative effects on cognition in children, such as schizophrenia and autism. Our investigation explored the possibility of a connection between increased parental age and increased cognition in children. We used online and printed databases to find the parental ages of approximately 800 prominent intellectuals and artists worldwide from the sixteenth century to 1958. We compared our data to mean parental ages of the general population in 2002 and 2006 using one-tailed t-tests. We found that both the maternal and paternal ages of notable creative and intelligent people were increased compared to the parental ages of the average population.

C40
The Effect of Endothelin-1 on Canine Atrial Myocytes

Presenter(s)
Andy Xu, Illinois Mathematics and Science Academy

Advisor(s)
Gary Aistrup, Northwestern University
Bill Marszalec, Northwestern University
J. Andrew Wasserstrom, Northwestern University

Endothelin-1 (ET-1) is a protein produced by vascular endothelial cells and acts as a powerful vasoconstrictor with potential for use in pharmaceuticals. In small animals ET-1 has been found to have a positive inotropic effect on cardiac excitation-contraction coupling, enhancing calcium ion transients and increasing risk of cardiac arrhythmia. Using fluorescent microscopes and fluorescent dye that increased in intensity with greater concentrations of calcium ions, our lab took images of canine atrial myocytes as ET-1 was added and plotted calcium ion concentrations over time. We removed extraneous data and corrected for deviations due to fluorescence gradually decreasing over time, and then compared the calcium transients of myocytes with and without the drug. The computer analysis that compares the transients has not yet been completed, but when analysis is done, the significance and values of the differences between transients will be presented.

C41
Determination of the Optimal Method of Transformation for MCF-10A Cells

Presenter(s)
Huiran Zhang, Illinois Mathematics and Science Academy

Advisor(s)
Abde Abukhdeir, Rush University
Sanja Turturro, Rush University

We sought to create a cellular model for the loss of the tumor suppressor gene phosophoinositide-3-kinase, regulatory subunit 1 (PIK3R1) in breast cancer using less toxic methods than traditional viral-mediated gene transfer, which is used to overcome the limitations of poor transfection efficiency and low gene targeting frequency. Clustered regularly interspaced short palindromic repeats coupled with expression of the Cas9 protein allows for very efficient gene targeting. Therefore, we investigated whether the improvement in gene targeting efficiency would overcome the gene transfer limitations of electroporation or chemical transformation. To test the efficiencies of these methods, we optimized several parameters, including voltage, capacitance, and cell number, and we visualized the results by transforming cells with plasmids tagged with either green fluorescent protein or m-cherry. We found that the MCF-10A cells did not survive electroporation. MCF-10A cells were viable following chemical transfection with both Lipofectamine and Fugene, but they did not express the fluorescent tags, indicating an unsuccessful transformation. However, as expected, we were able to successfully generate the model for genetic loss of PIK3R1 with viral infection. Therefore, electroporation and chemical transfection cannot replace viral transfection in the delivery of DNA in MCF-10A cells.

C42

The Mechanisms to Break the Vertebrate Ground Plan by Shifts of *Hox* Code in Skates, *Leucoraja erinacea*

Presenter(s)
Mickinney Zhang, Illinois Mathematics and Science Academy

Advisor(s)
Tetsuya Nakamura, University of Chicago
Neil Shubin, University of Chicago

Segmentation and regionalization in the vertebrate body plan has been conserved over a long evolutionary history. However, the conserved body plan was completely modified in skates, *Leucoraja erinacea*; the pectoral fin fused with the head and gill arch, resulting in a flat body. In addition, the wide pectoral and pelvic fins raised questions about body innervation patterns. To determine which molecular mechanisms developed the unique body, I investigated cell movements during the developmental process, the innervation and *hox* gene expression patterns. DiIC18(3) labeling and hematoxylin and eosin sections could not accurately track cell movements; yet, immunostaining of all nerves by 3A10 antibodies showed the cranial nerves entering the pectoral fins and the direct innervation of the posterior fin from the central nervous system without the brachial plexus, leading to the conclusion that cell movements and innervation patterns had been modified since the ancestral sharks. Nested expression in *hox* genes from the anterior to the posterior part of the body determines tissue identity and innervation patterns. Skate *hox* expression patterns by *in situ* hybridization indicate that *hoxa10* and *hoxa11* are candidate genes for the unique body evolution.

Business

D01
The Effect of Public Announcements on a Cell Phone Manufacturer's Performance in the Stock Market

Presenter(s)
Calvin Zhu, Illinois Mathematics and Science Academy

Advisor(s)
Pradeep Chintagunta, University of Chicago

A company may publicly announce the development of new products to generate financial advantages over competitors, indicated by a rise in stock price. Alternatively, some announcements, such as information regarding security exploitation, can have adverse effects on the company's success and drive its stock price down. To test the effects of public announcements on stock prices, I identified four cell phone manufacturing companies and compiled a list of their new product announcements within the past three years. Then, I gathered the end-of-day stock prices of the companies seven days before and after their announcements and used descriptive statistics to analyze the stock data. The results show that public announcements for new product development are ineffective, raising the stock prices by only 0.439% on average. Only eleven of the twenty announcements resulted in an increase in end-of-day stock prices. However, further research reveals that the nine cases of declined stock prices coincided with other undesirable events, and the combination of the two events ultimately reduced the stock prices. Furthermore, announcements that I expected to decrease the stock prices instead caused the end-of-day stock prices to increase by 1.72% on average. Thus, stock prices are often impacted by multiple announcements, and public announcements may not produce the expected results.

Chemistry

E01
Characteristics of Polymer Modification Using the Sequential Infiltration Synthesis Process Under High Pressure

Presenter(s)
Kyle Chen, Illinois Mathematics and Science Academy

Advisor(s)
Leonidas Ocola, Argonne National Laboratory

Atomic layer deposition (ALD) has been used in the electronics industry to manufacture items from semiconductor transistors to hard drives. Recently, with a wider variety of depositable materials, more work has been conducted in the field. We spun-coated silicon wafers with polymethyl methacrylate (PMMA) film and used an ALD system to embed Al_2O_3 and ZnO within the film. Using higher pressure and longer exposure times within the ALD chamber, we aimed to increase the amount of material deposited in the PMMA and examined samples using tools such as a photoluminescence spectrometer. We found that these changes successfully produce our target amounts of Al_2O_3 within the samples, allowing us to build ZnO into each sample as well. Our results suggest that more cycles of ZnO in the ALD produce larger quantities of ZnO in the sample. Additionally, data from a Nanolog Spectrofluorimeter has shown that the PMMA's photoluminescence is affected by the ALD process for both Al_2O_3 and ZnO. Peaks in the graph of emission intensity versus wavelength suggest that the two compounds strongly interact with the PMMA. After two years of work, we have made interesting discoveries through the examination of data and various graphs we have produced.

E02
Characteristics of Developed Polymethyl Methacrylate in Mixtures of Alcohol and Water

Presenter(s)
Maya Costales, Illinois Mathematics and Science Academy

Advisor(s)
Leonidas Ocola, Argonne National Laboratory

Polymethyl(methacrylate) (PMMA) is a common resist in electron beam lithography. We analyzed the effectiveness of alcohol and water mixtures as replacements for methyl isobutyl ketone (MIBK), a developer of PMMA. This paper will discuss the characteristics of ethanol/water and isopropanol (IPA)/water mixtures as PMMA developers. A series of 200 micron by 500 micron rectangular areas were exposed on the resist using an electron beam lithographer tool. The resist was then developed using varying concentrations of ethanol to water and IPA to water mixtures. Data showed mixtures of ethanol and water at a 4:1 volume ratio works as an effective developer and a replacement for methyl isobutyl ketone, a common and toxic developer. Analysis of developed PMMA under a Raman Spectroscope showed that mixtures of ethanol to water in a 4:1 ratio and IPA to water in a 3:1 ratio have different Raman vibrations than those of pure ethanol, pure IPA, or pure water. This helps gain insight as to why IPA and water are able to work as a developer together and not apart. Replacing MIBK with ethanol/water and IPA/water mixtures will reduce workplace risk, and hazardous waste disposal costs.

E03
Reducing Background Adsorption by Condensing Ethylene Glycol on Silica With Grafted Calixarenes

Presenter(s)
Ryan Franks, Illinois Mathematics and Science Academy

Advisor(s)
Justin Notestein, Northwestern University
Anthony Thompson, Northwestern University
Rachel Watson, Northwestern University

Silica with grafted calixarenes has shown promise as an adsorptive material due to the bowl-shaped structure that calixarenes have. Furthermore, these materials may enhance the efficiency of acetone-butanol-ethanol fermentation by adsorbing butanol and thus reducing the toxicity of fermentation broths. However, directly measuring the adsorption at calixarene sites on these materials is difficult due to background adsorption caused by residual hydroxyl groups on the surface of silica. Here, ethylene glycol oligomers (EG) were condensed to the oxide surface of silica with two distinct synthesis methods to reduce this background adsorption. Isotherms for the uptake of butanol by these new materials, untreated calixarene materials, silica, and silica with EGs were recorded using a refractometer and materials were characterized using thermogravimetric analysis. Material purification through extraction with nanopure water, a necessary step to reduce impurities, was shown to cause the loss of greater than 95% of the EGs for materials synthesized using both methods. Furthermore, for both synthesis methods greater than 30% of initially grafted calixarenes were lost. Thus, EG treatments are unable to isolate calixarene sites as the sole adsorbents.

E04
The Effect of Surface Treatments on Metal Catalysts for the Epoxidation of Cyclohexene

Presenter(s)
Ryan Franks, Illinois Mathematics and Science Academy

Advisor(s)
Justin Notestein, Northwestern University
Nicholas Thornburg, Northwestern University

Epoxides are valuable building blocks used in the synthesis of epoxy resins, sweeteners, drugs, plasticizers, and other commodities. However, most industrial epoxidation processes use environmentally harmful oxidants; hydrogen peroxide (H_2O_2) offers a more benign alternative, leaving behind only water as a byproduct. Development of commercial processes for H_2O_2 rely strongly on catalysts that can utilize this oxidant effectively. Materials composed of titanium oxide supported on silicon dioxide have been thoroughly investigated, and others suggest that post-synthesis surface modifications to the catalyst can improve reactivity and selectivity in epoxidation. Here, we study how organic surface treatments affect the reactivity and chemical selectivity of titanium, niobium, and tantalum oxides on silica for cyclohexene epoxidation at 65°C. Unmodified niobium catalysts have a non-radical epoxide selectivity of 90%, in contrast to 83% for tantalum and 56% for titanium. Capping the metal and surrounding surface with octyl chains decreases total product rate for all metals, while oligo (ether) caps decrease product rates for titanium and tantalum but increase rates for niobium. We further investigate other functional group modifications, including stearyl, benzyl, and perfluorinated caps. These simple surface treatments offer a platform for future catalyst design.

E05
Fabrication of a Methane Sensor by Zinc Oxide Functionalization of Multi-Walled Carbon Nanotubes

Presenter(s)
Ashu Gupta, Illinois Mathematics and Science Academy

Advisor(s)
Ralu Divan, Argonne National Laboratory
Md Humayun, University of Illinois at Chicago

The leakage of coal gas could be prevented through the detection of methane, which is its main chemical component. Our goal was to design a highly reactive methane sensor using carbon nanotubes (CNTs) on a silicon substrate. The CNTs were functionalized with zinc oxide (ZnO) by atomic layer deposition (ALD) at 175°C, 200°C and 225°C. ALD deposits thin films layer-by-layer onto the wafer and offers precise control over thickness. Due the inert nature of the CNTs before functionalization, the CNTs were activated with either oxygen plasma for 5 or 10 minutes or ultraviolet O_3 for 10, 20, 30, or 60 minutes. Preliminary results suggest that as the ALD process temperature increases, the ZnO peaks on energy-dispersive X-ray spectrograms become stronger and the images taken with scanning electron microscope show the ZnO crystalline structure. The sensor response was measured in a test chamber using a reference methane detector. Currently, our ZnO-CNT methane sensor detects a 2 ppm concentration of methane at room temperature, a reportedly high sensitivity. This sensor was prepared with 10 minute oxygen plasma treatment and 225°C ALD, concluding that this combination of activation and functionalization provided for the most effective methane sensor.

E06
Conjugation of Open Cage Decaborane Clusters to 1,3,4-Thiadiazole Using Propargyl Bromide

Presenter(s)
Nicholas Inocencio, Illinois Mathematics and Science Academy

Advisor(s)
Narayan Hosmane, Northern Illinois University

Boron neutron capture therapy (BNCT) for cancer treatment uses compounds containing the isotope boron-10, which can undergo nuclear fission when capturing neutrons and can target cancer cells to destroy them. Thiadiazole derivatives are present in drugs such as anticonvulsant drugs and anticancer drugs, and if a thiadiazole derivative that contains boron clusters was synthesized, we expect this species to exhibit significant anti-cancer activity. In this study, using deprotonation by the strong base potassium tert-butoxide and a displacement reaction with propargyl bromide, a thiadiazole derivative, 1,3,4-thiadiazole-2,5-dipropargylsulfide, was synthesized in order for its attachment to decaborane cages. Other possible methods involved direct coupling reaction with carborane cages and click chemistry, involving the synthesis of an azide compound and then linking it to decaborane to the derivative. Nuclear magnetic resonance (NMR) spectroscopy showed that direct attachment of decaborane to the thiadiazole derivative was ineffective. However, NMR spectroscopy confirmed that the production of the azide compound for click chemistry was successful. While we have not synthesized a derivative of 2,5-disubstituted-1,3,4-thiadiazole for its further use in BNCT, the synthesis of such a derivative by click chemistry is promising.

E07
Study of Hydrophilicity of Titanium Dioxide Thin Film Deposition on SnO_x by Water Contact Angle Measurements

Presenter(s)
Devdhi Kasana, Illinois Mathematics and Science Academy

Advisor(s)
Christos Takoudis, University of Illinois at Chicago

Atomic layer deposition (ALD) is a method that is used to alter the properties of various metals in order to render them more efficient for a wide variety of industrial and experimental uses. ALD reactors use bubblers to hold gaseous precursors that are cyclically pumped into the main chamber using a carrier gas. The main chamber contains the substrate upon which the precursors are deposited. When each substrate bonding site is bonded to a precursor molecule, the adsorption process halts and any remaining precursor is purged from the chamber. This self-limiting process allows for extreme control of property changes to the substrate. This study examined the change in hydrophilicity of tin oxide deposited on silicon plates after titanium oxide deposition. Plates with various layers of titanium dioxide of different thicknesses and annealing (extreme heat exposure) treatments were exposed to ultraviolet radiation. The plates were then tested and measured using water contact angle measurements. It was found that SnO_x is more hydrophilic than titanium dioxide, and that annealing increases hydrophilicity. Longer ultraviolet exposure improved the potential catalytic capabilities of the plate. This research can be applied to development of internal and dental medical devices to prevent corrosion and infection.

E08
The Effect of Benzoyl Peroxide and Salicylic Acid on MCF-7 Epithelial Cells

Presenter(s)
Jaida Lewis, Illinois Mathematics and Science Academy
Bria Williamson, Illinois Mathematics and Science Academy

Advisor(s)
Anita White, Illinois Mathematics and Science Academy

Benzoyl peroxide and salicylic acid, the most common active ingredients in face wash, have been known to alter the viability of skin cells. We tested 1%, 2.5%, 5%, 7.5%, and 10% solutions of benzoyl peroxide and salicylic acid on MCF-7 epithelial cells. Cells were exposed for 15 minutes. The longer the cells are exposed to the active ingredients, the more damage they experience. An MTT assay was performed on the cells in order to see the viability of the cells. Preliminary results suggest that salicylic acid has an effect on the cells while benzoyl peroxide does not. Different face washes and masks recommend different time periods for skin exposure to the product, and our results seem to be showing that time definitely affects the viability of the cells.

E09
A Study of the Properties of Films for Use in Organic Light Emitting Diodes

Presenter(s)
Liam McParland, Illinois Mathematics and Science Academy
Luke Morrical, Illinois Mathematics and Science Academy

Advisor(s)
C. Robyn Fischer, Illinois Mathematics and Science Academy
John Thurmond, Illinois Mathematics and Science Academy

Organic light emitting diodes (OLEDs) are very similar to common household light emitting diodes, except that organic films are used in their composition. OLEDs are an important emerging field in the electronics industry as they can be used to create screens and lights that are more efficient and versatile than conventional ones. Our investigation determined the properties of the films produced with the molecule m-MTDATA. Ultraviolet spectrophotometry and viscosity measurements were performed on solutions of this molecule at varying concentrations in the organic solvents chlorobenzene, dichlorbenzene, chloroform, and tetrahydrofuran. These solutions were then made into films using a spin-coater, and we performed ultraviolet and infrared spectrophotometry on these films. This data, along with that found in previous and future experiments on other molecules, should eventually allow researchers to determine trends in the properties of OLED molecules and how these affect the final OLED product.

E10
Determination of Surface Free Energy and Wettability of Atomic Layer Deposited CeO_2, ZrO_2, HfO_2, and Er_2O_3

Presenter(s)
Sarah Mou, Illinois Mathematics and Science Academy

Advisor(s)
Arghya Bishal, University of Illinois at Chicago
Christos Takoudis, University of Illinois at Chicago

A crucial property in solvent-substrate interactions, the wetting behavior of surfaces, can be determined using contact angle measurements. Factors such as the surface free energy of the solid and surface tension of the liquid influence the contact angle and surface wettability. We investigated the wetting behavior of the various oxide surfaces CeO_2, ZrO_2, HfO_2, and Er_2O_3, formed by atomic layer deposition (ALD). Using a goniometer and computer software, images of distilled water and diiodomethane droplets deposited on the surfaces were taken and analyzed to find their contact angles. Values of surface energy were calculated using our contact angle data in the Owens-Wendt-Rabel-Kaelble method. Preliminary results confirm the theoretical tendency of a higher surface energy as the contact angle decreases, suggesting higher hydrophilicity for surfaces with greater surface energy and hydrophobicity for those with lower surface energy. From measurements of contact angle, the surface properties of oxide thin films can be characterized, and optimizing the properties of these surfaces will have great potential in a variety of fields, including nanotechnology and biomedical materials.

E11
Electroanalytical Determination of Propranolol Using Flow Injection Analysis With Amperometric Detection

Presenter(s)
Joy Qiu, Illinois Mathematics and Science Academy

Advisor(s)
D'Nisha Hamblin, Michigan State University
Greg Swain, Michigan State University

The determination of pharmaceutical compounds in biological fluids using flow injection analysis with amperometric detection (FIZ-EC) plays a critical role in clinical and pharmaceutical analysis. Recently, nitrogen-incorporated tetrahedral-amorphous-carbon (ta-C:N) has drawn particular attention as an electrochemical detector used in FIA-EC, due to its inexpensiveness and versatility relative to other commonly-used carbon electrode materials. In this study FIA-EC was used to evaluate the viability of using ta-C:N and boron-doped diamond (BDD) thin film electrodes for the detection of propranolol (PROP) in synthetic urine; measurements were also made on glassy carbon electrodes for comparison. Hydrodynamic voltammetry experiments yielded very high optimum detection potentials for both ta-C:N and BDD, at 1.325 V and 1.35 V, respectively, and response variability was less than 5% response reproducibility for twenty-five consecutive injections of PROP on both electrodes. Analytical response curves exhibited linearity from 0.1-100 μmol/L PROP on ta-C:N and 0.08-100 μmol/L PROP on BDD, and respective sensitivities of 0.17 μA L/μmol and 0.15 μA L/μmol. Comparison with detection figures of merit for glassy carbon indicate that both BDD and ta-C:N are highly preferable to glassy carbon in amperometric measurements. Results furthermore indicate that ta-C:N, a more cost-efficient material, is equally as effective as BDD for the determination of PROP using FIA-EC.

E12
Understanding the Drainage of Foam

Presenter(s)
Vivek Vermani, Illinois Mathematics and Science Academy

Advisor(s)
Vivek Sharma, University of Illinois at Chicago

Foams are important in industry due to their usage in the oil recovery, cosmetic, food, and beverage industries. The purpose of this investigation was to see how changing properties such as viscosity and surface tension can alter the drainage time to help affect shelf life of foam-based products. Solutions were created with varying concentrations of glycerol to increase viscosity and Dawn® soap to decrease surface tension, and foams were formed by passing air flow into the solutions. Pictures of the foam and drained liquid were taken every minute. Results showed that both adding glycerol and Dawn® increased the time taken for the liquid to drain. Solutions with only Dawn® collapsed gradually while solutions that contained glycerol had longer lasting structures with collapsed suddenly. Adding more Dawn® had a more profound effect on the time it took for the foam to drain than adding glycerol. This suggests that surface tension may play a larger role in determining the time it takes for liquid to drain while viscosity has a larger role in the stability of the foam films.

E13
Structure and Activity of Sulfur-Based Radicals in Small Biological Compounds

Presenter(s)
Aspen Wheeler, Illinois Mathematics and Science Academy

Advisor(s)
Michael Lesslie, Northern Illinois University
Victor Ryzhov, Northern Illinois University

Mass spectrometry (MS) is used to study ionized compounds in the gas phase and can be used to test their structure and reactivity. Various classes of biological compounds and their models can be studied by MS, such as DNA bases. In special cases, sulfur can replace the oxygen on the three DNA bases: uracil, guanine, and cytosine. To analyze the reactivity of theses sulfur base radicals within biological systems, we reacted them with nitric oxide (NO), dimethly sulfide, and propanethiol. The three neutrals were chosen based on several preliminary studies of reactivity of 2-mercaptopyrdine, 3- mercaptopyrdine, and 4-mercaptopyrdine radical cations (as models for sulfur DNA bases) towards several neutrals. To form radical cations we utilized a method that has been applied extensively to a wide variety of biological compounds collisional activation of a ternary complex $[Cu^{II}(terpy)(M)]^{2+}$ during which the original sulfur base M transfers an electron to Cu^{II} , and upon fragmentation leaves as the oxidized radical cation $M^{\bullet+}$. Our data on sulfur bases display high reactivity (addition of $NO^{\bullet}$ and hydrogen atom abstraction from propanethiol) which is consistent with the radical located on the sulfur atom in the bases.

Computer Science

F01
Innate Learning: Understanding Binocular Visual Development Through Efficient Coding

Presenter(s)
Jorge Adorno, Illinois Mathematics and Science Academy

Advisor(s)
Mark Albert, Loyola University Chicago

Prior to eye opening in many animals, there are patterns of neural activity, characteristic blob-like patterns of activity that occur spontaneously and quickly dissipate. These patterns are an essential part of natural visual development. However, it remains unclear as to why these patterns form in the shapes they do. This work attempts to answer why these patterns form in this characteristic manner, using the principle of innate learning, assuming the early visual system learns from spontaneously generated patterns in the same manner as normal visual experience. Given this assumption, what patterns would be most beneficial for preparing the visual system before eye opening? Using a simple model of pattern generation in the developing lateral geniculate nucleus and primary visual cortex we were able to explore the space of possible patterns, from noisy speckled patterns to boundless waves of all shapes and sizes. We see that patterns that appropriately train the system for adult-like vision also happen to be the ones that we observe in real developing animals, proving evidence for this concept of innate learning in a binocular visual system.

F02
Using WProf to Analyze Page Loading Time in Webpages

Presenter(s)
Arun Arjunakani, Illinois Mathematics and Science Academy

Advisor(s)
Alexsandar Kuzmanovic, Northwestern University

The web page loading process is a little understood procedure. To solve this problem, Washington University created a program called WProf, which can analyze the different steps of a page loading process. For my experiment, I used WProf on several different sets of websites. For every test, I went directly to the website through a URL and recreated a new website by completely restarting Chromium, the browser that I used for the tests. My results showed that there were certain parts of the page loading process that took significantly longer to process. For example, the HTML parsing step could take up to 5 seconds, and can be about 50% of the overall page loading time. On the other hand, the page rendering time often look less than 2 seconds, and was sometimes less than 10% of the total loading time. Web page designers should definitely focus on reducing the length of the HTML parsing step.

F03
A Cloud-Based Front End for Real-Time Activity Recognition From Wearable Sensor Data

Presenter(s)
Arun Arjunakani, Illinois Mathematics and Science Academy

Advisor(s)
Mark Albert, Loyola University Chicago

Activity recognition research is limited; classification errors are generally observed only through off-line analyses. This does not permit a flexible, robust understanding of how the system works, since iterations take too long between recognition algorithm updates and their observable effects. Clinicians often have difficulty following the progress of their patients. Often, this requires expensive and time-consuming clinic visits, or patients tediously documenting their symptoms in a journal. In contrast, it is possible to monitor patient progress objectively and continuously using wearable sensors, however the current activity recognition algorithms need improvement to be used clinically. In order to speed improvement of these algorithms, we have created a more intuitive interface. Our system uses Heroku, an elegant and simple web client, to host our application. Our system can observe the performance of activity recognition algorithms in real-time so we can more quickly make necessary changes to improve performance. This is especially beneficial for clinicians, but also has uses for researchers using activity recognition. As a demonstration, we use accelerometer and gyroscope from a wearable Shimmer3 sensor to identify whether a patient is sitting, standing, walking, wheeling, or stair climbing. Using such information, doctors can get a more accurate picture of the patient's progress.

F04
Investigations on and Repairs to Issues With the Current Residential Checking System at IMSA

Presenter(s)
Rakesh Chatrath, Illinois Mathematics and Science Academy
Tiger Shi, Illinois Mathematics and Science Academy

Advisor(s)
Fred Yankowski, Illinois Mathematics and Science Academy

The residential staff of the Illinois Mathematics and Science Academy are interested in having both software improvements and additions to their current student checking program to increase their work efficiency and effectiveness. Our overarching plan was to develop a system in which students would be able to be check-in at any hall during the designated check period. We administered a survey and interviewed residential counselors to pinpoint the issues of the current check program. We analyzed the data to draft a plan for our Universal Check program, which we will administer to residential counselors and determine its effectiveness. The results of this survey suggested that subjects were most interested in reducing the redundancy and time consumption of the current system. Likewise, after interviews with residential counselors, the data was used to keep the Universal Check program simple and efficient: a web-based application with database functionality to log students' names from any hall. This functionality would increase convenience for students and for residential counselors, with a finely tuned application, efficiency for their jobs.

F05
Downed Aircraft: A Search and Rescue Flight Path Interpolation Tool

Presenter(s)
Daniel Costa, Illinois Mathematics and Science Academy

Advisor(s)
Pierre Bierre, Algorithmic Geometry
Namrata Pandya, Illinois Mathematics and Science Academy

Recent aircraft disappearances such as Air Malaysia Flight 370 and Air France Flight 447 demonstrate the need for global geolocation software capable of estimating the location of a downed aircraft. Contemporary struggles to accomplish this are due to aircraft transponder failure, which results in a loss of contact between ground support and the plane's crew and systems. To fix this, Eclipse Java software was used to develop an application to aid search and rescue teams in locating missing aircraft more quickly and efficiently. Contemporary algorithmic geometry concepts were used to render three-dimensional graphics to illustrate the geolocation of the aircraft determined by an interpolation algorithm. This location is determined using data collected immediately before loss of contact, including scheduled take-off and landing coordinates, flight plan, elevation, and velocity, among other factors. This application will serve as groundwork for up and coming implementations of powerful algorithms to make successful and resourceful search and rescue missions possible.

F06
Acceleration and Rapid Prototyping of Real-Time Computer Vision Applications Written in Python

Presenter(s)
Matthew Dyas, Illinois Mathematics and Science Academy

Advisor(s)
Brian Donahoe, Digital Design Corporation

As computer vision is used in more modern applications such as self-driving cars and object recognition, the number of hours spent on the development of these technologies increases. The time spent designing, writing, and debugging code determines the rate at which these products can be completed and eventually made available for commercial and consumer use. In order to decrease the time of development, methods of rapid prototyping can be applied which eliminate the limitations of testing code on suboptimal devices such as personal computers. By using the interpreted programming language Python, as well as libraries that facilitate the implementation of computer vision and multiprocessing, real-time computer vision applications can be run on an average laptop. Python is ideal for debugging purposes and does not require any compile time. Preliminary results of testing various libraries and frameworks suggest that the built in multiprocessing module offers the greatest improvement in the frame rate of real-time computer vision applications. Algorithms such as face detection have shown improvements of up to 33% faster frame rates when multiprocessing is applied, making it practical to prototype similar applications.

F07
Minimal Probing Algorithms for Membership Queries on Large Sets

Presenter(s)
Sachin Govind, Illinois Mathematics and Science Academy

Advisor(s)
Noah Prince, Illinois Mathematics and Science Academy

Answering: Is X in the set? queries with minimal probes represents a critical step towards creating faster computing systems. This investigation aimed to extend Andrew Yao's work to answering membership queries where one is given access to less of the data with an algorithm that requires a constant number of queries. Yao showed that given half of the universal set, one could answer membership queries with a single probe, indicating that binary search was not the most efficient algorithm for unsorted sets. Two algorithms were developed as a result of this investigation. The first one enabled compression of an entire table into a handful of values, which could then be quickly decompressed. The second algorithm was an extension of Yao's work based on a staggered table structure. Resulting algorithms were both successful in maximizing the size of the set that could be dealt with given a constant number of probes. Testing of algorithms was performed through rigorous casework analysis, which showed that both algorithms can efficiently resolve membership queries, although more work is required to find the most efficient constant probe encoding scheme.

F08
Designing Artificial Intelligence Algorithms That Outperform Humans in Simulated Real-World Scenarios

Presenter(s)
Kushagra Gupta, Illinois Mathematics and Science Academy
Noor Michael, Illinois Mathematics and Science Academy

Advisor(s)
Phadmakar Patankar, Illinois Mathematics and Science Academy

Artificial intelligence has, since its inception, played a large role in the development and use of modern technology. With applications such as financial modeling, game theory, and robotics programming, it has the potential to be used to assess and possibly even surpass the bounds of human reasoning and decision making. The goal of this investigation was to determine what algorithmic techniques could be employed to make decisions and analyze risk in real-world scenarios consistently in a more effective manner than humans can. Through the use of a simulation that employs the key elements of decision making in the real world, and an analysis of human performance against algorithms that are designed to take advantage of said components, a general technique can be developed that would be capable of consistently outperforming humans at decision making and risk-reward analysis. Preliminary experimentation has shown that a combination of a heuristic analysis of the board and an appropriate application of risk is the most effective way to create an algorithm that outperforms humans at decision making in our simulated real-world environment. In the future, such algorithmic techniques could be used to assist and possibly even replace humans in the decision making process.

F09
Designing an Augmented Reality Particle Detector to Teach Fermilab Visitors About Neutrinos

Presenter(s)
Gene Kim, Illinois Mathematics and Science Academy

Advisor(s)
Benjamin Carls, Fermi National Accelerator Laboratory

Augmented reality (AR) overlays computer generated sounds, images, or symbols onto the physical world. The purpose of this investigation was to design an AR particle detector to teach people about neutrinos. At Fermilab, I investigated the neutrino interactions that MicroBooNE could discover. After learning about neutrinos, I practiced creating objects using Unity, a game creation tool, and gave behaviors to the particle detectors. These behaviors can cause parts of the particle detector to become visible and invisible. The Vuforia Unity Extension makes a Unity program into an AR program. It presents AR applications using a camera. I integrated the Unity particle detector and the Vuforia program to produce the images on a screen. It can be accessed as an app on computers or mobile devices. MicroBooNE specializes in neutrino investigation, and this app can help Fermilab visitors understand the research in neutrinos. We want to use an AR particle detector to explain the interactions neutrinos have with particle detectors.

F10
The Combinations and Modifications of Delays

Presenter(s)
Arun Kumar, Illinois Mathematics and Science Academy

Advisor(s)
Ben Sutherland, Columbia College

Signal processing is the modification of a digital or analog audio signal used in many media productions but most commonly in music. My investigation focused on the uses of delay, the repetition of sound, in signal processing. I used MAX 7, a visual programming language for multimedia, to create programs using delays. I built on these programs to combine and modify multiple delay lines. The result was a Karplus-Strong synthesizer, a synthesizer that delays white noise to create sounds similar to string instruments. I used different filters created from delays to alter the synth to make drum sounds as well. By combining the multiple delay-based synthesizers, equalized through delay-based filters and altered by adding delay-based effects, I was able to create an audio sample using just delayed white noise that resembles a band of instruments. The project exemplifies the power and implications of the repetition of sound.

F11
Performance Comparison of the Transmission Control Protocol and User Datagram Protocol in Supporting a Video Streaming System Programmed Using Java

Presenter(s)
Angela Lee, Illinois Mathematics and Science Academy
Isabella Lee, Illinois Mathematics and Science Academy

Advisor(s)
Phadmakar Patankar, Illinois Mathematics and Science Academy

The Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) are two of the most widely used transport layer protocols for streaming video. In this investigation, we quantitatively compared the performance of TCP and UDP when used in a video streaming system programmed using the Java programming language. After familiarizing ourselves with socket programming, we modified a UDP-based video streaming program to create a separate TCP-based version. We then coded both the UDP and TCP program to calculate packet loss and delay to assess the performance on three network conditions when the client and server were directly connected to each other, on the same local area network, and on different networks. An analysis of the packet loss and delay data suggested that UDP had potential for losing packets while TCP retransmitted all lost packets so the packets were all delivered eventually. However, there was a greater average time difference between consecutive packet arrivals for TCP than for UDP because of these retransmissions. By understanding the advantages and disadvantages of TCP and UDP and their differences on various network conditions, video streaming services can choose the more suitable protocol for their application to provide a higher quality viewing experience.

F12
The Singularity: What is it, Where Will it Come From, and How do You Survive?

Presenter(s)
Vishal Patel, Illinois Mathematics and Science Academy
Ray Sun, Illinois Mathematics and Science Academy

Advisor(s)
Mike Ososky, Applied Computer Technology

In the Information Age, artificial intelligence (AI) has become an important part of daily life. As AI becomes more capable, it will match human capabilities, becoming strong AI. In order to explore strong AI and its implications, we read and discussed many books, from holistic viewpoints like *The Mind's I* to reductionist viewpoints like *Connectome*. We learned that technology improves exponentially and it is extremely difficult to stop its progress. The most important technologies allow us to spread ideas more effectively. As technology improves, it will reach the point where ideas can replicate without humans; that point is the Singularity. That technology is strong AI, which is a complex, adaptive system that contains an input stream, isomorphism, and an output mechanism. This type of system can use self-organizing networks, evolutionary algorithms, and recursive searches as the gateway to complexity. These systems are radically improving current AI, increasing their capabilities in ways researchers don't understand. As we create more complex AI, our understanding of how they work is diminishing. Without this understanding, it is impossible to know if AI can be safe. While artificial intelligence continues to grow in importance, it will eventually overtake us.

F13
Extending Java to Include Traits for Method Reuse

Presenter(s)
Kody Puebla, Illinois Mathematics and Science Academy

Advisor(s)
John Reppy, University of Chicago

In Java, classes are defined by data fields and the methods that perform operations on that data, in addition to fields and methods of any of its parent classes. In most cases, a well-constructed class hierarchy, defining the relationships between parent and child classes in a program, is enough to keep code concise. But in more complicated programs, it is common for identical code to appear in multiple classes, which results in a complicated program that is inefficient to write and maintain. My investigation is focused on building a new unit in Java called a trait. Traits are created separately from the class hierarchy as a way to deal with the issues of method reuse. Polyglot, a project created specifically for extending Java, provides the framework to define how traits would operate in Java. The prototype is still being built and its status will be presented at IMSAloquium. The current plan for the extension allows multiple classes to use trait-defined methods without requiring a common parent class. This will make future programming in Java more concise and easier to modify, providing many new possibilities for constructing programs.

F14
An Algorithm to Find the Height of a Multihop Wireless Network's Strip Yielding Maximum Efficiency

Presenter(s)
Lydia Stone, Illinois Mathematics and Science Academy

Advisor(s)
Peng-Jun Wan, Illinois Institute of Technology

Today, our world revolves around wireless devices such as cellular phones, which rely on a multihop wireless network (MWN) to function. MWNs are facing scheduling problems - difficulties with supplying interference-free communication to the maximum number of people. To resolve these scheduling issues a MWN must be subdivided efficiently. I investigated the partition of a MWN in a new, potentially more effective way, into horizontal strips of uniform height h, exploiting a previously unknown nature of MWNs, strip-wise transitivity of independence (SWTI). By mathematically manipulating geometric interpretations of SWTI in MWNs, I constructed the worst case, a particular subgroup of links that yields an h that satisfies SWTI for all other subsets. Using this worst case, I successfully developed an algorithm that calculates the previously unknown h, producing a more efficient method to fix scheduling problems and reduce telecommunications troubles. I also analyzed and proved the validity and tightness of this algorithm. Diagrams were drawn using basic hand tools, Microsoft Word, and Adobe Reader XI. My results theoretically have the potential to accomplish great technological feats. To generate more material results, actual models and simulations of my proposed MWN subdivision and algorithm would need to be constructed and tested.

F15
Designing a Novel Algorithm to Analyze Organelles in the Cell

Presenter(s)
Yash Thacker, Illinois Mathematics and Science Academy

Advisor(s)
Yang Li, Northwestern University
Jane Wu, Northwestern University

Determining if organelles in the cell are functioning and determining which paths they are taking are important for understanding how the cell is operating. The mitochondria play a role in making adenosine triphosphate (ATP) for the cell. In order to determine how the organelle is accomplishing these tasks, such as making ATP, can be understood by looking at the paths that it takes within the cell. Currently this information is obtained using a manual process and by using manually developed kymographs that can take a long time to analyze and can produce inaccurate data. I worked on coding an algorithm using MATLAB software and equations developed by other researchers. The automated algorithm that will be used to analyze the images has already been developed, but it is undergoing a testing phase in which we are comparing the coordinates out-putted by the algorithm to the coordinates determined by manual analysis.

F16
Software Rejuvenation in Cloud Computing

Presenter(s)
Jacqueline Vega, Illinois Mathematics and Science Academy

Advisor(s)
Shangping Ren, Illinois Institute of Technology

Software rejuvenation is the process which slows down the process of a computer system's performance degradation. Cloud computing is the use of virtual machines to provide users the ability to process information and use resources on a system that is not owned by them. A literature review was done on eighteen different papers in this field with the earliest date being 2007, and it was found that the most frequently used operating system was Ubuntu, six core machines were running, and these papers looked at the optimal time to rejuvenate before the failure state. A virtual machine with similar conditions on a cloud system was provided at the Illinois Institute of Technology, and the conditions used were similar to these other papers on the subject. An Ubuntu operating system with one gigabyte of memory was used for each virtual machine that was created. Preliminary trials are being run in order to see how the virtual machine would respond to certain stimuli such as bugs in the system.

Economics

G01
Statistical Arbitrage and Execution in Exchange-Traded Fund Markets

Presenter(s)
Timothy Gietl, Illinois Mathematics and Science Academy

Advisor(s)
Brian Green, TransMarket Group
Maxwell Rhee, TransMarket Group

When the price of an exchange traded fund (ETF) diverges from the net value of the underlying assets that constitute its portfolio, an arbitrage opportunity exists between the ETF and its underlying assets, under the assumption that they will eventually converge. Developing markets tend to have a greater opportunity for this arbitrage, especially when the ETF and underlying assets are in different markets in different currencies. Due to illiquid assets constituting the ETF portfolio, as well as high transaction costs associated with purchasing an entire portfolio, these arbitrage opportunities are difficult to profit from. In this study, we look into constructing an underlying portfolio similar to the ETF (similar constituents and correlation) that will allow us to minimize transaction costs in an effort to make the arbitrage opportunity profitable. By monitoring the value of our ETF tracking portfolio versus the ETF price, we can make trades when the two diverge from one another by selling the higher priced portfolio/ETF and buying the lower priced portfolio/ETF. Results will be presented showing whether the strategy of optimizing ETF tracking and transaction cost is profitable, as well as whether this strategy makes equity markets more efficient.

G02
Algorithm for Market Dynamics in the Trade-At-Settlement Futures Markets

Presenter(s)
Huajie Huang, Illinois Mathematics and Science Academy

Advisor(s)
David Lorentzen, TransMarket Group

In the financial derivatives markets, it is crucial to understand the market dynamics in terms of the volume distribution. In order to investigate this, a Python script was developed to analyze the volume distribution by fitting a beta distribution, characterized by parameters alpha and beta that perfectly describe the distribution, to the volume data. By calculating the deviations of alpha and beta values from 1, one should be able to quantify the deviations of the volume distribution from a uniform distribution. Preliminary results show that the volume distribution for a particular futures product is far from uniform, but further testing must be done to verify this. Through analyzing these deviations from uniform distributions one can gain a better understanding of the current market dynamics and perhaps use Bayesian inference techniques to infer future market dynamics.

G03
Extracting Zero Rates and Discount Factors From Treasury Bonds

Presenter(s)
Camden Ko, Illinois Mathematics and Science Academy

Advisor(s)
David Lorentzen, TransMarket Group

United States Treasury bonds can be used as an estimation for the time value of money. By calculating the zero rates and discount factors of those bonds, the valuation of United States dollars, USD, can be approximated. Using bond data prices, the discount for future contracts on treasury bonds was found. From there, I generated a corresponding chart which displayed the rate at which money lost its value over time; that is, money loses its value the longer one has to wait to receive it. Using Newton's Method a linear approximation that could estimate values for anytime between the present and one-hundred plus years was generated. Only one of many methods for linear curve fitting was used. However, with my current code, there's a shell that can house more complex methods. These approximations allow for a heightened understanding of general bond trends. These trends affect nearly all loans, domestic or international. Anything ranging from student loans to mortgages to personal loans are under the influence of United States Treasury bonds.

G04
Effects of Weather Forecasts on the Planting Decisions of Farmers

Presenter(s)
Vivian Liu, Illinois Mathematics and Science Academy

Advisor(s)
Tatyana Deryugina, University of Illinois at Urbana-Champaign

Climatologists generally agree that the inevitable increase in emissions of greenhouse gases will lead to increased precipitation and high temperatures in the future. A prominent discussion topic in environmental economics is the effect of climate change on the agricultural sector. Previous studies have typically used either the production function approach, which offers estimated effects based on specific crop yield, or the hedonic approach, which offers estimated effects based on land value. However, previous studies have not taken into account any adaptation farmers might make in the face of predicted weather changes. This study attempts to quantify the effects of different temperatures on corn, soybean, wheat, and cotton yields using multiple fixed effects regression models in R, a statistical analysis application. Hot temperatures during the early season were seen to persist during the growing season. Growing season hot temperatures, expectedly, had detrimental effects on crop yields. Interestingly, hot temperatures during the early season moderated the effect of growing season hot days. Presumably, this is because farmers are able to recognize the validity of weather forecasts, and make adaptations like changing crop distribution, soil type, or irrigation methods. Considering farmer adaptation in response to climate change is necessary in developing accurate models for predicting future crop yield changes.

G05
The Effect of Competitive Natural Gas Prices on Air Quality and Public Health in the United States

Presenter(s)
Daniel Pechi, Illinois Mathematics and Science Academy

Advisor(s)
Steve Cicala, University of Chicago

Numerous epidemiological studies have demonstrated that there exists a strong correlation between negative respiratory health effects and particulate matter (PM). PM production by coal burning power plants is contrasted with the cleaner byproducts of natural gas burning power plants which are turned on or off depending on pricing and demand factors. This study examines these correlations through academic literature, power plant load data, geographic information systems (GIS), aerosol optical depth data, and economic figures related to shifting natural gas prices. Through analysis of these sources, it was determined that surface PM levels could be ascertained by taking data from PM-monitoring sites and data from NASA's MODIS and MISR satellites. PM produced by power plants was isolated by overlaying hourly load data from individual power control areas (PCA). Weather factors were accounted for by looking at relative humidity data and by analyzing this data through the GEOS-CHEM model. Levels of PM were eventually overlaid onto a PCA map using the QGIS software system in order to visualize how each PCA controlled PM output. Although it appears that a correlation exists between lower natural gas prices and reduced pollution-related mortality, it remains inconclusive whether this correlation holds on a national scale over the past decade.

G06
Optimizing Delta Hedging for the Trading of U.S. Treasuries Options and Futures

Presenter(s)
Joy Qiu, Illinois Mathematics and Science Academy

Advisor(s)
Faris Hitti, TransMarket Group

Derivatives trading plays a major role in market liquidity and the global economy, and thus strategies are constantly being developed to increase efficiency and optimize margins. For example, U.S. Treasury options trades are often hedged with futures in order to reduce delta, or price risk. This study examines the general trends in the movement of futures prices at different time offsets to an options trade, using data from options trade logs and a database containing futures tick data. Specifically, a weighted midpoint calculation was used to represent the futures price, as it accounts for both bid and ask sizes and is thus a more accurate reflection of value. Using a computer program written in the Python programming language, tick data was appropriated off of the trade timestamp, and price differences for similar trades were calculated and compared. Preliminary results indicate that market fluctuations are entirely random, and further statistical analyses and tests on larger datasets are expected to confirm this conclusion. The results of this study further indicate that market influences do not become more or less adverse with respect to time; more variables may be investigated in the future to further optimize delta hedging.

G07
Existence of Post-Earnings Announcement Drift in Brazilian Financial Markets

Presenter(s)
David Xu, Illinois Mathematics and Science Academy

Advisor(s)
Brian Green, TransMarket Group
Maxwell Rhee, TransMarket Group

Post-earnings announcement drift (PEAD) is one of financial economics' most important and thoroughly documented anomalies. In previous decades financial researchers have tested and confirmed its existence in numerous countries such as the United States, Canada, China, and Britain. Post-earnings announcement drift is the correlation between a company's announced earnings and its future stock returns. When a company earns more than investors expect, then its stock price will rise for an extent of time. Conversely, the price will drop when the company underperforms investors' expectations. In an efficient market all information should be properly priced and reflected in a stock's return. If we observe systematic deviations away from efficiency, this behavior is anomalous. By studying the returns of each stock against its earnings, we can determine the presence of a trend in abnormal stock returns. Due to the lack of research in the Brazilian financial markets, an important contribution would be to document the presence of this phenomenon. For this study, we replicated similar studies conducted in other countries and used two classical asset pricing models, the capital asset pricing model and the Fama-French Model, to isolate the company-specific PEAD effects. These asset pricing models normalize for well-known factors, such as company size, company valuation, and market risk that influence stock price returns.

Education

H01
Creating the Customer Archetype for English e-Learning in India

Presenter(s)
Puja Mittal, Illinois Mathematics and Science Academy

Advisor(s)
Saurabh Chopra, Leap Learning Solutions PVT LTD
Apar Sureka, Leap Learning Solutions PVT LTD

The goal for any startup is to increase its volume of customers in order to increase profit. The startup EnglishLeap, an English education platform geared towards Indians, wanted to convert customer's interest in learning English into paying for the product. In order to determine how to convert the users to customers, we electronically distributed two surveys with questions about demographics, preferred form of offline content, and areas of focus within English (listening comprehension, reading, speaking, and writing). We categorized customers into three groups: those not willing to pay for online learning, those willing to pay, and those who were already paying customers. The archetype of those customers who were willing to pay and already paying was a working male between the ages of 25-44 whose main motivation to learn English was for career growth. The main area of English that customers wanted to improve was speaking fluency, so EnglishLeap created online classes to target them. We found that for all three groups, an ebook was the preferred form of offline content whereas those who were not already paying were also interested in improving their grammar. EnglishLeap then created a grammar ebook to act as an incentive to start paying for the product.

Engineering

I01
Investigation of Potential Benefits of Unmanned Aerial Vehicles

Presenter(s)
Kevin Chen, Illinois Mathematics and Science Academy

Advisor(s)
James Gerry, Illinois Mathematics and Science Academy

The potential benefits of unmanned aerial vehicles (UAVs) are unbounded. While organizations such as the military utilize them rather extensively, UAVs can also improve the lives for the general public from lowering taxes to potentially saving lives. To investigate their capabilities, we first had to build several test airframes to analyze their strengths and weaknesses. Many of the test airframes were simple tube and wing designs, where a wing is mounted near the middle of a tubular fuselage for simplicity. These airframes were evaluated in its takeoff performance, minimum and maximum speed, handling characteristics during low and high speeds, landing distance, and general reliability. Eventually the tube and wing design was finalized for its excellent ability to take off and land on short runways, great controllability at all speeds, and its overall simplicity and ease of flight. We then mounted a simple camera onboard the aircraft and ran several test flights. The aircraft easily handled the payload and all the flights were able to capture usable video. In conclusion, the UAVs built demonstrated the capability to carry payload and perform aerial surveillance, critical for search and rescue missions.

I02
Developing a Mission Communication System for High Altitude Balloons

Presenter(s)
Tyler Cluff, Illinois Mathematics and Science Academy
Roopa Rajesh, Illinois Mathematics and Science Academy

Advisor(s)
Lou Nigra, Adler Planetarium
Ken Walczak, Adler Planetarium

The use of high altitude balloons (HABs) has recently become common in fields such as astronomy and atmospheric science. HABs are utilized in studying the atmosphere and gathering quantitative data such as pressure and humidity. These balloons can reach great altitudes, eventually bursting under low pressure, dropping the payload many kilometers from the launch site. Utilizing an Arduino microcontroller, we developed programs that allowed us to send commands to the HAB to ensure proper functionality. It is vital that communication is maintained between the HAB and ground controllers so as to be able to receive data when needed and send commands up to the payload, such as cutdown, the pre-burst separation of the balloon. This is made possible by the two transceivers that comprise the system (one within the payload, one on the ground). We improved the existing code with the implementation of various features including a frequency scanning program and a means of data collection, with the end goal of developing a successful cutdown protocol. We also produced system performance predictions and tested them for accuracy. Development of this two-way communications system enables flight operators to efficiently monitor and control the HAB.

I03
Thermodynamic Analysis of the Heusler Alloy Nickel-Manganese-Tin

Presenter(s)
Drake Eidukas, Illinois Mathematics and Science Academy

Advisor(s)
Susan Meschel, Illinois Institute of Technology
Philip Nash, Illinois Institute of Technology

Heusler alloys, discovered in 1903, have been intensely studied for their potential properties, such as shape memory. Our alloy, nickel- manganese-tin (Ni_2MnSn), first requires thermodynamic analyses before any major research on can be performed. In order to answer the question: What are the thermodynamic properties of the Heusler alloy Ni_2MnSn? we performed X-ray diffraction analysis, electron microscopy, hardness tests, and calorimetry on several 0.1 gram samples. We performed calorimetry in order to determine the enthalpy of formation and entropy of the alloy, X-ray diffraction to ensure a complete reaction occurred, and electron microscopy to determine the composition of the alloy. Furthermore, we performed differential scanning calorimetry to learn about the phase diagram and melting point. Our results show that the alloy's composition is single-phase, is magnetic, and has a unit cell parameter of 6.07 angstroms, enthalpy of formation of -20.5 kilojoules/mole of atoms, hardness of 588 kilogram-force/mm^2, and entropy of 32.4 joules/mole/degree. Still in progress is finding the heat of fusion of the alloy. All these data will allow development of applications of Ni_2MnSn, which could have shape memory properties or be a sensor for use in magnetic fields due to its sensitivity to magnetic forces.

I04
The Elastic Properties of Silicon Functionalized Graphene Nano-Platelet Reinforced Potassium Geopolymer by the Impulse Excitation

Presenter(s)
Erik Seungwoo Nam, Illinois Mathematics and Science Academy

Advisor(s)
Shinhu Cho, University of Illinois at Urbana-Champaign
Waltraud Kriven, University of Illinois at Urbana-Champaign

Geopolymers are inorganic materials that are being considered to be an alternate for ordinary Portland cement due to their low carbon dioxide emission rate and stronger mechanical properties. However, they are brittle materials and have limitations in their applications, but this issue can be solved by mixing the geopolymer slurry with a reinforcing material. Graphene nanoplatelets were used to reinforce potassium geopolymer, creating functionalized and nonfunctionalized graphene nanoplatelet reinforced potassium geopolymers, sGNP KGP and GNP KGP, with different nanoplatelets contents (1, 2, 3 weight percent). The impulse excitation test was used to measure their mechanical strengths and was compared to the theoretically predicted the moduli values. The GNP KGP results matched the modified Halpin Tsai with exponential factors, while the sGNP KGP results did not match to the modified Halpin Tsai with exponential factors. The elastic modulus of 1wt% sGNP KGP was 8.49 GPa was greater than pure KGP which was 8.45 GPa; however, the 2 and 3wt% values were decreased to 8.48 GPa and 8.39 GPa, respectively. The GNP KGP composite results showed similar results as well. The 1wt% GNP KGP had a value of 8.68 GPa, but the 2wt% and 3wt% GNP KGP had values of 8.59 GPa and 8.53 GPa, respectively.

I05
Evaluation of the Efficiency of Contemporary Contact Precautions and the Development of a New Barrier Precaution Prototype

Presenter(s)
Eleanor Naudzius, Illinois Mathematics and Science Academy

Advisor(s)
Peter Clancy, Illinois Mathematics and Science Academy

Contact and barrier precautions serve to protect healthcare workers and decrease hospital inquired infections of organisms which spread through vectors and fomites. However, various sources indicate that current precaution methods, such as the use of gowns and gloves, are inefficient both in the prevention of infection and effect on the environment. In response, we decided to explore the efficiency of current isolation gowns and their effects on the environment. We used processes from the American Association for Medical Instrumentation standard PB70 to test five common types of gowns consisting of polyethylene, polypropylene, polypropylene- polyethylene mixes, and reusable gowns. Preliminary results from hydrostatic pressure tests indicate high resistance to hydrostatic pressure in materials containing polyethylene or reusable material, and low resistance in materials consisting only of polypropylene. Initial bacterial penetration tests indicate that all materials were penetrable with *E. coli*, though reusable materials and materials containing polyethylene showed less growth by inspection. All materials, except one of the two samples of polypropylene, were impenetrable with bovine blood. Once testing had finished, we began to design a new gown prototype. In terms of efficiency in purpose, polyethylene-based materials were most efficient. Environmentally, reusable gowns were the most efficient.

I06
Designing a System for the Magnet Shimming Trials of the Muon g-2 Experiment

Presenter(s)
Paul Nebres, Illinois Mathematics and Science Academy

Advisor(s)
Brendan Kiburg, Fermi National Accelerator Laboratory

Fermilab is repeating the muon anomalous magnetic moment experiment from the Brookhaven National Laboratory (BNL) with more precision. This is to confirm whether new physics beyond the standard model was responsible for the observed deviation between the experimental and theoretical results. A laser tracker system is being implemented to more precisely measure the position of the magnet's trolley platform, used to help create a homogeneous magnetic field. The work includes creating and connecting the different software and hardware components for this system. The Maximum Integrated Data Acquisition System (MIDAS) was utilized towards developing a system to organize these measurements during runs. These measurements will ultimately aid us in more accurately creating a homogeneous magnetic field. The work we have done has resulted in a system that can automatically prompt the laser tracker to take data and transfer the data to a MIDAS file. Hence, we have successfully been able to coordinate and standardize the measurements from the multiple probes. The laser system can decrease the uncertainty from 50 ppb to 30 ppb and pinpoint where magnetic field impurities occur. This is a major component in improving the BNL experiment which hopes to improve our understanding of the basic components of matter.

I07
Providing Power for an Ultraviolet Light Water Purifier for the Developing World

Presenter(s)
Sean Potempa, Illinois Mathematics and Science Academy
Grant Williams, Illinois Mathematics and Science Academy

Advisor(s)
Mark Carlson, Illinois Mathematics and Science Academy

Many developing countries lack access to clean water, spreading waterborne diseases. We are collaborating with another group to engineer a cheap, self-sustainable, ultraviolet light, water purification device. They have demonstrated killing with a 9 watt source and are working to reduce that power draw. We are attempting to create a power supply for use in the field. We have tried various arrays of thin film solar panels as well as tradition crystalline ones. Currently we are finding the practical upper power limit for an inexpensive hobby generator driven by a gear train as opposed to a simple hand crank. Solar cells were abandoned when 7 dollar arrays produced less than 0.1 watt of power, about a factor of 100 below what is needed. In addition, the rate of increase in power with respect to light intensity rapidly falls off. Spinning a generator itself at 3500 RPM, we have achieved a power of about 0.3 watts. With use of a gear train, we aim to increase this number by a factor of 3 or 4. It may be sufficient to power a device in the field if the other team is able to decrease the power need by a similar factor.

I08
Designing a DC-DC Converter for the Mu2e T-Tracker

Presenter(s)
Sattvic Ray, Illinois Mathematics and Science Academy

Advisor(s)
Aseet Mukherjee, Fermi National Accelerator Laboratory

The Mu2e experiment, set to start taking data in 2020, will look for the conversion of muons to electrons without neutrino production. The detector's transverse tracker will require step-down DC-DC converters to bring input power at 48V down to the voltages required by the various components, which range from 1.2V to 5V. A buck converter is an efficient step-down design that uses an inductor to store energy. To be suitable for use in the tracker's periphery, the inductor must have a nonmagnetic core, making it larger and more expensive than most commercially available inductors. In this study, the inductor was created with traces on a printed circuit board (PCB), a process that is expected to be cheaper for mass production than the alternative of winding wire around plastic toroids by hand. The converter's efficiency was tested over a range of 10V-48V input, 1.2V-7V output, and with 4.6 Ohm, 6.2 Ohm, and 12.6 Ohm loads. The converter operated at 82% efficiency for conversion from 48V to 7V at1.13A output, and 75% efficiency for 48V to 5.2V at 0.84A output. These efficiencies are comparable to those found for hand-wound inductor converters, suggesting that PCB inductors are a viable, cheaper alternative.

I09
Development of Open Source Ultrasonic, Dust, and Solar Panel Sensors

Presenter(s)
Mylee Rolock, Illinois Mathematics and Science Academy

Advisor(s)
Akram Ali, Illinois Institute of Technology
Brent Stephens, Illinois Institute of Technology
Zach Zanzinger, Illinois Institute of Technology

Sensors are important in our everyday lives. They help with many factors, including comfort, health, and reducing energy consumption. Unfortunately, they are expensive. For my investigation I built open source sensors because they cost less and perform the same task. My goal was to build open source sensors for the scientific community for a significantly lower price. I made an ultrasonic sensor, dust sensor, and solar panel sensor. The ultrasonic sensor is used to detect the occupancy at a desk or in a room, the dust sensor is used to measure dust density, and the solar panel sensor is used to detect how bright the sun is. To make these, I had to assemble the hardware, program them, and put them in an enclosure. The ultrasonic sensor ended up working out well, but the dust sensor and solar panel sensor did not. The ultrasonic sensor did exactly what it was supposed to, measuring how long someone had been at the desk. It was accurate and cheap, my goals for the project. I believe these can advance the scientific community by providing important sensors for less. Sensors are essential, and open source sensors could significantly help the scientific community.

I10
A Multiplexed Readout Scheme for a Large Array of Photomultiplier Tubes

Presenter(s)
Adit Suvarna, Illinois Mathematics and Science Academy

Advisor(s)
Jin-Yuan Wu, Fermi National Accelerator Laboratory

The Hyper-Kamiokande is an experiment projected to take place in the Kamioka Zinc Mine in Japan in 2023, with the purpose of finding out more about subatomic particles. The experiment uses 99,000 photomultiplier tubes, instruments that send a signal when hit by photons. However, to send the signal to the computers, several long cables were used to connect each photomultiplier tube individually to the computer in the cases of the Kamiokande and the Super-Kamiokande. This is not an option for the Hyper-Kamiokande given the large amount of photomultiplier tubes used. Last year, a prototype of a new layout was created, utilizing a single piece of cable to connect to all of the photomultiplier tubes, also using small circuits to minimize signal loss across junctions. The prototype was successful, and therefore, this year, a new prototype layout was tested utilizing a differential circuit instead. This prototype also tested successfully, correctly sending signals programmed by a pulse generator from several different nodes to the end of the array with little disturbance. Thus, both this prototype and last year's prototype are viable models that could be used in the Hyper- Kamiokande experiment.

I11
Design and Construction of a Water Purification System Utilizing Ultraviolet Light

Presenter(s)
Nikhilesh Thota, Illinois Mathematics and Science Academy
Franklin Ye, Illinois Mathematics and Science Academy

Advisor(s)
Mark Carlson, Illinois Mathematics and Science Academy

Diseases like dysentery spread in developing countries in water contaminated with bacteria. Our goal was to create an affordable water purification system which could supply a family with enough water. We examined the killing ability of ultraviolet light (UVL), specifically ultraviolet C (UVC). To do this, we tested 2 UVL sources on samples of *Escherichia coli* by placing a sample and a UVL source in a chamber and running it for times ranging from 5 minutes to 2 days. After plating, counting, and comparing exposed samples, we found that a 9 watt mercury vapor bulb (254nm, UVC) could kill more than 99.99% of *E. coli* in less than 10 minutes. However, a 3 watt bulb (UVL) did not kill effectively. Another group has not been able to create enough affordable power to run either bulb. We are also trying to concentrate the Sun's UVL to kill via ultraviolet or heat. To increase the treatment rate, we are in the process of building a gravity-fed flow-through chamber. In conclusion, ultraviolet radiation at shorter wavelengths (UVC) can effectively kill bacteria in a modest amount of time. We are working toward providing enough clean water for a family per day.

I12
Effect of Double Aging and Room Temperature Aging on Properties and Stress Corrosion Cracking of the Aluminum Alloy AA7075

Presenter(s)
John Valin, Illinois Mathematics and Science Academy

Advisor(s)
John Hasier, Illinois Institute of Technology
Susan Meschel, Illinois Institute of Technology
Philip Nash, Illinois Institute of Technology

The double aging heat treatment process of AA7075 has led to a substantial reduction of aging time over that required for the industry standard T6 procedure and with only about a 10% decrease in strength. The effect of room temperature aging prior to artificial aging has also been investigated since this is a common industrial practice after extrusion. This work investigates the effect of double aging on the stress corrosion cracking susceptibility of double-aged material compared with the T73 treatment conventionally used to improve the stress corrosion cracking resistance of aluminum alloy AA7075 by method of hydrogen embrittlement and subsequent three point bend testing. The hydrogen embrittlement process has demonstrated that it is an effective corrosion procedure for testing. Preliminary results suggest that the double aging process does not have significant corrosion resistance properties in comparison with the T73 heat treatment, although these are still being confirmed. The other tested heat treatments do not show any useful corrosion properties. These results relate in that the double-aging process has been shown to not provide significant corrosion resistance when compared to the industry standards of heat treatment.

I13
Composition Analysis of Solid Oxides Deposited Through Atomic Layer Deposition

Presenter(s)
Thomas Wan, Illinois Mathematics and Science Academy

Advisor(s)
Sathees Selvaraj, University of Illinois at Chicago
Christos Takoudis, University of Illinois at Chicago

Solid oxide fuel cells can convert chemical energy directly into electricity without the use of combustion. However, they have to operate at high temperatures due to the electrolyte used, a type of solid oxide. Through atomic layer deposition (ALD), a thin solid oxide electrolyte, which is more efficient and requires a lower base temperature to operate, can be created and used in fuel cells. The precursors of zirconium and titanium were placed into the ALD system and ZrO_2 and TiO_2 were deposited onto a silicon wafer. Using an ellipsometer, the thickness of the film was measured, and the composition of the film was determined. Analysis of an atomic layer deposition of TiO_2 yielded a thickness of 33 nanometers after about 700 cycles of ALD and analysis of an atomic layer deposition of ZrO_2 resulted in a thickness of 18 nanometers for 200 cycles of ALD. For TiO_2, each cycle added about 0.047 nanometers to the thickness, and for ZrO_2, each cycle added about 0.09 nanometers. An XPS spectra of the titanium-based film determined that the film was not entirely pure and had superfluous molecules like nitrogen embedded within. A pure solid electrolyte will operate more efficiently because those superfluous molecules can hinder the ion transfer process.

English

J01
This is the End: Gendered Closure in Victorian Literature, 1840-1859

Presenter(s)
Ana Curtis, Illinois Mathematics and Science Academy

Advisor(s)
Leah Kind, Illinois Mathematics and Science Academy

Victorian novels often end with a chapter in which the fates of nearly all the important characters are described. In many cases, the characters allied with the protagonist receive happy endings and those regarded as morally bad end in more distasteful ways. However, the definition of a happy ending often differs for male and female characters. This investigation takes note of every character mentioned by name in eight British novels published between 1840 and 1859, the middle of the nineteenth century and the beginning of the Victorian era, and categorizes them as bad, good, or neutral in nineteenth-century moral terms before taking note of their gender and their ending. Endings are also evaluated for certain elements, including marriage, change in social station, and death before these elements are compared with the morality and gender of the character. Though not all the data has been evaluated, it currently suggests that females change their marital state by the end of a novel more frequently than males do and that good characters do tend to receive more positive endings. Whether this applies to characters of lesser importance as well as the most important characters has yet to be determined.

J02
Evolution of Feminine Archetypes in Russia From Folklore to the Literature of the Twentieth Century

Presenter(s)
Manojna Namuduri, Illinois Mathematics and Science Academy

Advisor(s)
Daniel Gleason, Illinois Mathematics and Science Academy

Literature is a powerful cultural indicator that both reflects and resists change through time and space. This investigation confronts the Russian perception of gender by observing how feminine character archetypes have or have not shifted with changes in culture. A series of published folkloristic analyses were applied to the collections of Russian folklore and modern poems, short stories, and novels. These analyses were based on character actions, traits, psychology, and development. The characters in both sets of literature were compared using these analyses in order to determine how archetypes have changed or remained stagnant. The results point towards feminine archetypes resisting change, and masculine archetypes accepting change. This results in a stratification which establishes that feminine characters remain static as their male counterparts are allowed to be dynamic. Feminine characters do not have as much agency as and are largely peripheral to masculine characters. Themes like ennui and misery are depicted through the suffering of feminine characters for the sake of the development of masculine characters. The disparity between gender archetypes reveals a patriarchal influence shown in and perpetuated through influential literature that may limit female readers while enabling male readers.

Environmental Science

K01
A Chemical Equilibrium Analysis of Mercury Adsorption Onto *Escherichia coli* Surfaces

Presenter(s)
Katherine Su, Illinois Mathematics and Science Academy

Advisor(s)
Jean-Francois Gaillard, Northwestern University
Sara Thomas, Northwestern University

The bacterial biouptake of mercury (Hg) in aquatic environments may result in the synthesis of the neurotoxin methylmercury. Before it is internalized by bacteria, Hg must interact with the cell membrane. This study quantifies Hg adsorption onto *E. coli* cell membranes by applying concepts of equilibrium thermodynamics to reactions occurring at the bacteria-fluid interface. We use potentiometric titrations to determine deprotonation constants for the various functional groups on the membrane in the presence and absence of Hg to determine those responsible for binding Hg. We performed adsorption experiments at various pH's to quantify site-specific complexation. The acid-base properties of the *E. coli* cell membrane in the absence of Hg can be characterized by invoking four functional groups. For titrations with Hg, the concentration of the thiol groups (logK = -8.8, where K = acid dissociation constant) decreases while the others (hydroxyl, carboxyl, phosphoryl, and amino) remain the same. This suggests that Hg forms a strong bond with membrane thiols that cannot be broken during the titration. The Hg adsorption isotherms indicate that cells will adsorb approximately 90% of added Hg when pH = 5.5, where the fraction of Hg bound decreases with increasing pH. Overall, these results suggest that thiol groups on cell membranes are responsible for bindig Hg and that the fraction of Hg that will bind is pH dependent.

History

L01
Roles of Women Worldwide in World War II

Presenter(s)
Jamie Candler, Illinois Mathematics and Science Academy

Advisor(s)
Claiborne Skinner, Illinois Mathematics and Science Academy

After World War I countries realized that there were roles in war for women. When World War II (WWII) started the demand for men to fight was high, so women started to fill non-combat roles to free up men for fighting. This investigation looked at the roles that women filled in WWII worldwide. Through journal articles, primary sources, and books compiled of many different women's war stories I found the different roles that women filled. I found about seventy women's stories of what they did in the war. These women had some of the dirtiest jobs in the war. I found some common themes between their stories. Many of the women went overseas in the war and were close to the front. These women were putting their lives on the line to help in the war. Many of these women never thought of the danger of their jobs, they just thought they were doing their jobs. These women have been forgotten by history. Through my investigation, I want to show that these women were essential to the war effort and should be honored for what they did.

L02
Racial and Ethnic Relations in America During World War II

Presenter(s)
Fiona Kurylowicz, Illinois Mathematics and Science Academy
Emily Schuster, Illinois Mathematics and Science Academy

Advisor(s)
Claiborne Skinner, Illinois Mathematics and Science Academy

A study of World War II generally places an emphasis on the European and Japanese conflict. The dynamics between various racial and ethnic groups in America and the effect of the war on these relationships are less thoroughly studied, although equally important. Examining mid-twentieth century films and propagandist materials exposed the biased mindset of many Americans, and primary source documents and contemporary analyses of historical events revealed that the modern American racist culture has its roots in the earliest European immigration to the continent. As this nation was founded on the beliefs of White Anglo-Saxon Protestant immigrants, over time it became exclusive and condemnatory of invading immigrant cultures, assigning stereotypes to Black, Asian, and select Eastern European ethnicities. However, the Second World War triggered a remarkable shift in racial tolerance, as the US government recognized that a solidified war effort demanded a united home front. The government proposed the release of propaganda films intent on changing the public mindset. These, among numerous other factors, brought a new perspective on racial equality to returning soldiers and civilians alike, which was disseminated into popular culture. Ultimately, the duration of the war left no US stereotype unchanged.

L03
An Examination of the Source of the Instability of the Mexican Government After Independence From Spain

Presenter(s)
Cristal Quinones, Illinois Mathematics and Science Academy

Advisor(s)
Eric Smith, Illinois Mathematics and Science Academy

Mexico gained its independence from Spain in 1821.The autonomy of Mexico resulted in a government whose political structures were failing as well as widespread degeneration of the religious, economic, and social elements of the new independent republic. This investigation examines why this was the case, by synthesizing a number of sources. In investigating the religious, political, and financial institutions in addition, it appears that the tensions within Mexican society due to the diverse needs and desires of the population led to further instability. This investigation focused mainly on political institutions, class and ethnic tensions, and the interaction between these two that resulted in the instability. This study suggests that the source answer lies in the personal motivations of the political leaders. The inability for the various political factions to agree on what they wanted meant that the institutions could not meet everyone's needs. There are still under-investigated issues but I have concluded that political leadership suggests that both social class tensions and political institutions were the primary factor. This follows a general trend within the field.

L04
Economic Implications of Chinese Presence in Africa: Foreign Aid, Migration, and Resource Extraction

Presenter(s)
Ziang Wang, Illinois Mathematics and Science Academy

Advisor(s)
Ralph Austen, University of Chicago

While most studies on the China-Africa relationship have concentrated on Chinese extraction in Africa, few have comprehensively analyzed the economic impact of Chinese involvement on Africa. To understand the various influences China exerts on African economic development, this investigation begins with an examination of secondary literature on the nature, extent, and modalities of China's relationships with its African partners. Next, the investigation uses several countries as case studies to evaluate the economic impact attributable to Chinese agricultural investments, educational and professional development programs, and bidirectional migration. Resource insecurity, caused by its recent export-oriented economic growth, drives China to seek raw materials from African nations. Due to competition from established companies, China incentivizes corrupt regimes with agricultural, educational, and infrastructural aid packages in exchange for resource access. These resource extraction activities generate significant economic growth but minimal development. Despite the lack of economic development generated, Chinese education and training programs have potential for economic development. However, Chinese migration to Africa largely hinders local growth. By analyzing Chinese resource extraction and aid packages, this study proposes a fuller depiction of the impact on African economic development and proposes that China's actions are similar to Western engagements with Africa.

Law

M01
The Challenges of Apprehending Identity Thieves: Methods and Techniques That Police Officers Can Use to Investigate Identity Theft

Presenter(s)
Joseph Longo, Illinois Mathematics and Science Academy

Advisor(s)
James Bondi, Illinois Mathematics and Science Academy

Identity theft is America's fastest growing crime, indirectly and directly leading to expenses totaling twenty-five billion dollars every year. However, this also happens to be one of America's most overlooked crimes as it is often seen as an unsolvable case. The purpose of this investigation was to gather information concerning investigative tactics on identity theft and compile them into a single document, intended to be used by officers of small police departments inexperienced with solving said cases. By speaking with officials from the United States Secret Service, Illinois State Police, and the Aurora Police Department, along with reading previously published training manuals, I created a series of flow charts detailing the exact procedures that an officer should follow to trace the theft back to the criminal. These flow charts were then supplemented with step-by-step diagrams and screenshots that allow for the reader to learn new skills necessary to solving identity theft cases, such as tracing an IP address to its owner. By documenting these processes, I hope to assist law enforcement in their pursuit of crime, and hopefully one day, rid the world of identity theft.

Mathematics

N01
Unitary Braid Representations of B(3) to SU(2)

Presenter(s)
Emily Jia, Illinois Mathematics and Science Academy

Advisor(s)
John Boller, University of Chicago
Niels Nygaard, University of Chicago

Quantum Computation Language (QCL) utilizes unitary operators to describe the temporal evolution of a quantum system. However, the unitary group is infinite and cannot be programmed directly into a quantum computer. We identify three families of dense unitary braid representations that generate all quantum gates operating on a single qubit with a finite number of generators. Then we extend a result by Kauffman in generalizing solutions to the Yang-Baxter Equation in the special unitary group SU(2). Each solution *(g, h)* provides a map from the braid group B(3) to SU(2) that preserves the braid product. This creates a group homomorphism so that every element in SU(2) can be approximated arbitrarily well by the matrix images *g, h* of generating braids of B(3). We find three families of *g* that are useful in producing common quantum functions, such as the Hadamard gate. We also find the explicit form of a quaternion *f* such that the operator $\Phi_f(g) = fgf^{-1} = h$ maps a value of *g* to its paired YBE solution *h*. The resulting representation with *g, h* generates single qubit quantum gates in SU(2) and we aim to find their explicit form.

N02
The Erdos-Hajnal Conjecture: Case for T-Monotone Curves

Presenter(s)
Alan Liang, Illinois Mathematics and Science Academy

Advisor(s)
Andrew Suk, University of Illinois at Chicago

Ramsey Theory is a deep field with mathematics motivated by the underlying philosophy: complete disorder is impossible in a sufficiently large system. An open conjecture in the field, known as the Erdos-Hajnal conjecture, states that for every graph H, there exists a constant c(H)>0, such that every H-free graph G has either a clique or independent set of size at least |V(G)|^c(H). We define a graph as H-free if the graph does not have an induced subgraph isomorphic to graph H. Furthermore, a clique is a graph with each pair of vertices connected, while an independent set is a graph with no two vertices connected. In this investigation, we look at the Erdos-Hajnal conjecture for t-monotone curves, that is, a curve in the plane with t-1 vertical tangency points. Our results show that for a family of n t-monotone curves in the plane, one can find n^(1/5^t) t-monotone curves that are pairwise monochromatic crossing or pairwise disjoint. Future studies would focus on establishing results for pairwise crossing t-monotone curves.

N03
Examining Different Factors That Help Predict a National Basketball Association Player's Future Monetary Value

Presenter(s)
Christopher Rogers, Illinois Mathematics and Science Academy
Mark Rogers, Illinois Mathematics and Science Academy

Advisor(s)
Mary Myers, Illinois Mathematics and Science Academy

The sport of basketball is increasingly being analyzed by statistical analyses that often help many general managers make decisions about how to distribute a team's payroll among its players. A recurring problem with paying players is that many general managers are unsure of how to accurately determine how much their players should earn, particularly their star players. Using the National Basketball Association's free agent class of 2014 we examined approximately ten charts and graphs related to individual performance, team performance, and the player marketability. We decided to divide our analysis into three categories: effectiveness, age, and marketability. To measure the player's effectiveness over the previous season, we used win shares, which measures both individual and team performance. We also took into account age and marketability, which indirectly affect the future income of the player. These categories take into account different factors which affect player worth, since one would most likely think that salary should be based purely off performance. All these categories take into account different factors which aid in determining a free agents salary/worth. Using these statistics to make predictions about how a player will perform in the future will help general managers realize what their players are worth in their future plans so they can adjust their payroll accordingly.

N04
Analyzing an Entailed Variant of the Impartial Game Nim

Presenter(s)
Aquila Ryu, Illinois Mathematics and Science Academy
Brice Wang, Illinois Mathematics and Science Academy

Advisor(s)
Micah Fogel, Illinois Mathematics and Science Academy

In combinatorial game theory an impartial game features a set of valid moves and outcomes based solely on the state of the game. In other words, the state of the game is independent of the player currently moving. Popular games of this category include Nim, Sprouts, and Green Hackenbush. We analyzed an entailed variant of the game Nim to determine which properties of simpler impartial games hold. In this variant, an entailed move is defined as a move that grants the current player another move. Players take turns making entailed moves until one is unable to, whereupon that player loses. Of particular importance, the Sprague-Grundy Theorem states that each state of an impartial game can be associated with a numeric value, often called its Grundy value. We designed algorithms in Java to produce Grundy values for different game states of our variant game. Our algorithms use a dynamic programming approach in which game states of increasing complexity are evaluated inductively from a simple base case. We observed patterns between similar pile configurations and their respective Grundy values. Our results provide a baseline from which to further analyze this and similar variants of Nim.

N05
The Understanding and Analysis of the A5/1 Stream Cipher Utilized in Security of Everyday Cell Phones

Presenter(s)
Jason Yang, Illinois Mathematics and Science Academy

Advisor(s)
Byol Kim, University of Chicago
Lek-Heng Lim, University of Chicago

The security of everyday technology such as the cell phone has been a common concern for the general population. This investigation represents the process of understanding and analyzing the A5 stream cipher utilized in the encoding and security of all common cell phones. This would come from first utilizing modular arithmetic and finite field arithmetic, as well as a series of theorems such as Fermat's little theorem to understand the cipher's methods, as well as running statistical tests upon the numbers. These components were utilized to analyze linear shift feedback registers (LSFR), which the A5/1 cipher utilizes. It was understood that the stream cipher utilizes three different LSFRs in a complex system and yields a pseudorandom stream of numbers, in which the numbers and generated and fed back into the linear shift feedback register. Further, although the statistical analyses are in a preliminary stage, they have not thus far been completed. These results will be completed and presented thoroughly at a later date and their analyses will provide conclusions regarding the level of overall security of the A5/1 stream cipher.

Medicine

O01
Endoscopic and Histologic Disease Activity are Associated With Risk of Hospitalization and Colectomy in Patients With Ulcerative Colitis

Presenter(s)
Max Ackerman, Illinois Mathematics and Science Academy

Advisor(s)
Ruben Colman, University of Chicago
Sarah Goeppinger, University of Chicago
David Rubin, University of Chicago

Ulcerative colitis involves chronic inflammation of the large intestine. Severity of disease has traditionally been determined by symptoms alone, but recently the value of endoscopic and histologic information for stable remission is appreciated. The endoscopic and histologic data for a consecutive one-hundred ulcerative colitis patients at the University of Chicago was collected. Biopsies from identical diseased locations in the colon were then graded by two pathologists using previously validated scale of histologic severity between 2005 and 2007. Thirty-nine patients have follow-up data with identical endoscopic and biopsy data prior to May of 2010. Correlative analysis was performed to determine patient outcomes in relation to these changes over time. Of eleven patients whose endoscopic score increased, three (27.3%) patients were hospitalized and none had a colectomy. When endoscopic scores decreased, no patients were hospitalized and one (3.7%) patient had a colectomy. Furthermore, of thirty-five patients whose histologic scores increased in follow-up, three patients were hospitalized (8.6%) and one (2.9%) patient had a colectomy. When histologic scores decreased, no patients were hospitalized or had a colectomy. When scores increased, the probability that a patient would be hospitalized or undergo a colectomy increased. These results demonstrate that surgery and hospitalization outcomes are associated with both endoscopic and histologic findings over time and have implications for treatment of patients with ulcerative colitis.

O02
Sepsis-Associated Modulation of Pentraxin and Other Inflammatory Mediators

Presenter(s)
Edward Carson, Illinois Mathematics and Science Academy

Advisor(s)
Jawed Fareed, Loyola University
Debra Hoppensteadt-Moorman, Loyola University
Michael Mosier, Loyola University
Amanda Walborn, Loyola University

Sepsis is a serious pathologic syndrome resulting from a systemic infection causing generalized whole body inflammation. Early diagnosis of the condition is crucial to survival. The measurement of various blood coagulation biomarkers of endogenous pathogenesis provides information on early diagnosis. Six biomarkers that were identified as potential indicators of sepsis are pentraxin (PTX3), procalcitonin (PCT), interleukin 6 (IL-6), interleukin 10 (IL-10), myeloperoxidase (MPO), and C-reactive protein (CRP). In this study, these biomarkers were measured and compared in plasma samples from one-hundred sepsis-associated coagulopathy (SAC) patients to samples from fifty normal individuals using individual enzyme-linked immunosorbent assay methods. The results showed that all six biomarkers were significantly elevated in SAC patients in comparison to normal patients by t-test ($p < 0.05$). Individually, PTX3 had a markedly elevated percent change from normals of 3770% ($p = 0.0005$), whereas PCT had 1718% change ($p < 0.0001$), IL-6 had 8134% change ($p < 0.0001$), IL-10 had 876.3% change ($p < 0.0001$), MPO had 16881% change ($p < 0.0001$), and CRP had 2347% change ($p < 0.0001$). The generation of these six biomarkers provides additional insights on the pathogenesis of this syndrome and the mechanisms involved. The elevation of these markers may correlate with the severity of sepsis and can be used as diagnostic and prognostic indicators to manage SAC.

O03

Using Peptide Phosphorodiamidate Morpholino Oligomers to Inhibit Phosphoglycerate Mutase Within Tachyzoites of *Toxoplasma gondii*

Presenter(s)
Sarah Dovgin, Illinois Mathematics and Science Academy

Advisor(s)
Kamal El-Bissati, University of Chicago
Joseph Lykins, University of Chicago
Rima McLeod, University of Chicago
Kelsey Wheeler, University of Chicago
Ying Zhou, University of Chicago

Toxoplasma gondii is a microscopic protozoan parasite present within sixty million people in the United States alone, and approximately one third of the global population. Phosphoglycerate mutase (PGM) is a metabolic enzyme within the glycolytic pathway of *T. gondii* with potential to aid in parasite motility, replication, and invasion; inhibition potentially decreasing parasite viability. Gene expression of PGM within *T. gondii* was inhibited via the splicing out of the enzyme's second exon using PGM specific peptide phosphorodiamidate morpholino oligomers (PPMO). A yellow fluorescent protein (YFP) assay measured efficacy of PGM-specific PPMO on the ability of parasites to replicate in human foreskin fibroblasts (HFF) along with a WST-1 assay to determine the absence of toxicity of PGM specific PPMOs. Experiments are currently being planned to determine whether there is splicing of the second exon in PGM by PPMO by extracting RNA from *T. gondii* parasites, reverse transcribing the RNA into complementary DNA (cDNA), amplifying cDNA through polymerase chain reaction, and then running amplified cDNA through gel electrophoresis to document splicing. From the YFP and WST-1 assays, 10 micromolar seemed to be the best concentration of PGM specific PPMO for optimal knockdown of parasite replication and without toxicity to HFFs.

O04

Analysis and Inhibition of Ornithine Aminotransferase Within *Toxoplasma gondii* Oocysts, Tachyzoites, and Bradyzoites

Presenter(s)
Sarah Dovgin, Illinois Mathematics and Science Academy

Advisor(s)
Kamal El-Bissati, University of Chicago
Joseph Lykins, University of Chicago
Rima McLeod, University of Chicago
Kelsey Wheeler, University of Chicago
Ying Zhou, University of Chicago

Toxoplasma gondii, an apicomplexan parasite affecting one-third of the world's population, causes the disease known as toxoplasmosis. The parasite is shed by a feline host, as sporozoites, whereupon they have the ability to infect most mammals. Ornithine aminotransferase (OAT), an enzyme involved in amino acid synthesis and essential to the urea cycle, was identified through an enzymatic crystallography pipeline as a potential *T. gondii* target. Transcriptomic and proteomic studies of *T. gondii* have demonstrated increased levels of OAT in early sporozoites. Western blots utilized to test antibodies of OAT at varying concentrations against OAT recombinant protein produced visible protein bands at a dilution of 1:3000. Further studies will be conducted, analyzing the ability of antibodies to detect OAT in *T. gondii's* three life stages. A CRISPR/Cas knockdown as well as inhibitory compounds will be tested for efficacy in OAT inhibition. A multi-sequence alignment analyzed amino acid sequence of *T. gondii* which shared a region of common cysteines only with *Plasmodium falciparum*, indicating a potentially targetable region. Successful identification of OAT as a viable enzymatic target as well as the development of methods of inhibition may be useful to reduce infectious cat form oocysts within the environment, benefitting public health.

O05
The Association Between a Single Nucleotide Polymorphism of the CALC 1 Gene and Malaria in the South Indian Population

Presenter(s)
Lohitha Guntupalli, Illinois Mathematics and Science Academy

Advisor(s)
Ch. Venkataramana Devi, Osmania University
Prasad Kotiklapudi, Osmania University

Malaria is a prevalent parasitic infection that occurs in tropical and subtropical regions, often correlated with poverty stricken areas. This project investigated the association of the polymorphism in the exonic region of the CALC 1 gene and malaria in the South Indian population. The blood of thirty patients suffering from malaria and thirty healthy patients were used to isolate their DNA, amplify the CALC 1 gene region through polymerase chain reaction (PCR), and analyze the PCR products to find the association between the presence of the CALC 1 gene polymorphism and malaria in the South Indian population by using restriction fragment length polymorphism. It was concluded that there was no significant association between the polymorphism of the CALC 1 gene and malaria in the South Indian population. This lack of association could be due to a small sample size. If an association of the polymorphism and malaria was found, it could be used to assess the severity of the disease and patients' reaction to treatment.

O06
Effects of Exercise and Manual Therapy on Weight Loss and Lower Extremity Functional Mobility

Presenter(s)
Lija Hoffman, Illinois Mathematics and Science Academy

Advisor(s)
Amy Anichini, Revolution Fitness
Lela Fausze, Revolution Fitness
Ben Wax, Revolution Fitness

My investigation studies the relationship between an individual's weight loss and changes in his or her lower extremity functional mobility, respective to the type of physical therapy they received. If supported, such a relationship could shed new light on physical therapy and what measures should be taken for the greatest results. I analyzed patient records for the type of therapy they received, their weight loss, and their self-assessed mobility scores over a two month period. I organized these patients into two groups within an excel spreadsheet, those who received a combination of exercise and manual therapy and those who received exercise therapy alone. After conducting regression analysis and calculating p-values, my data indicated that there is no significant correlation between an individual's weight loss and the change in their lower extremity functional mobility, regardless of the type of therapy a patient received. The results of my investigation oppose the previous published findings. This discrepancy may be due to limited sample size and subjective lower extremity functional mobility scores.

O07

Mechanisms of Host-Viral Interactions in the Gut Leading to Loss of Oral Tolerance: A Prerequisite in Celiac Disease Pathogenesis

Presenter(s)
Fengling Hu, Illinois Mathematics and Science Academy

Advisor(s)
Romain Bouziat, University of Chicago
Reinhard Hinterleitner, University of Chicago
Bana Jabri, University of Chicago

Interplay of genetic and environmental factors, like viruses, can lead to the initiation of autoimmunity. Celiac disease (CD) is an inflammatory intestinal disorder with autoimmune components where genetically susceptible individuals (HLA-DQ2 or HLA-DQ8 positive) develop inflammatory T-cell and antibody responses to dietary gluten. An avirulent enteric virus has been shown to cause an antiviral response which leads to the loss of the oral tolerance (LOT) characteristic of CD. In mice we established the ability of reovirus to break oral tolerance to fed antigen by unsettling intestinal T-cell homeostasis. We compared mice infected by two reovirus reassortants, T1L which induces LOT in mice, and T3D-RV which doesn't, using microarray and quantitative polymerase chain reaction. We analyzed different sites of the gut, including Peyer's patches, mesenteric lymph nodes, and lamina propria. Data from these sites allow us to confirm the contributions of type-1 interferon-dependent pathways, type-1 interferon-independent pathways, and manipulation of gut microbiota through regulation of antimicrobial peptides to the LOT induced by T1L infection. This investigation is the first step towards revealing the mechanisms through which virus infection can induce LOT and set the stage for CD pathogenesis.

O08
The Correlation Between Neonatal Disease Severity and the ABO Blood Group

Presenter(s)
Divya Jasthi, Illinois Mathematics and Science Academy
Faith Leslie, Illinois Mathematics and Science Academy
Hope Leslie, Illinois Mathematics and Science Academy

Advisor(s)
Kacie McMahon, Loyola University
Jonathan Muraskas, Loyola University Chicago
Renae Reisig, Loyola University Chicago

The AB blood group is known to be significantly correlated with adult cardiovascular diseases, preeclampsia, and neonatal necrotizing enterocolitis. However no current studies show a significant correlation between the severity of neonatal and pregnancy-related diseases and the AB blood group. Our investigation analyzed 1,525 neonates admitted to the Loyola University Medical Center Neonatal Intensive Care Unit from 1990-2005. We compared the severity of retinopathy of prematurity, culture proven sepsis, intraventricular hemorrhage, respiratory distress syndrome, patent ductus arteriosus, and transient neutropenia in addition to the pregnancy-related maternal complications of preeclampsia, hypertension, and chorioamnionitis in the AB blood group to the control blood groups: A, B, and O. Using a chi-square test, we found that neonatal blood group was a significant factor in the early-onset of neutropenia ($P<0.001$) and the occurrence of sepsis during neonatal hospitalization ($P=0.0002$). Blood group may also be a factor in the development of maternal hypertension ($P=0.0732$). Further analysis showed that culture proven sepsis and transient neutropenia are significantly correlated with the AB blood group ($\chi^2=21.41$, $df=3$, $P<0.0001$; $\chi^2=26.60$, $df=1$, $P<0.0001$). These findings establish an association between hypertension and transient neutropenia that could result in impaired bone marrow response and increased susceptibility of infection in AB blood group neonates.

O09
Burn Injury Alters the Intestinal Microbiome and Increases Gut Permeability and Bacterial Translocation

Presenter(s)
Omair Khan, Illinois Mathematics and Science Academy

Advisor(s)
Abigail Cannon, Loyola University
Mashkoor Choudhry, Loyola University
Zackary Earley, Loyola University
Adam Hammer, Loyola University
Niya Morris, Loyola University

Half a million burn injuries resulting in four thousand deaths are reported nationally every year. Previous studies have shown that burn patients suffer a global immune response characterized by a breakdown in epithelial barrier integrity in the gut, leading to inflammation and sepsis. However, the diversity of the intestinal microbiota following thermal injury and its implications in inflammation and infection are unknown. Male C57BL/6 mice were subjected to a 20% body surface area burn or sham burn and sacrificed on days one and three. DNA was isolated and purified from the small and large intestine feces along with other extra intestinal sites. This DNA was subjected to quantitative polymerase chain reaction to quantify specific bacterial groups found within the gut microbiome. Quantitative polymerase chain reaction analysis of the DNA isolated showed significant alterations in specific bacterial groups within the gut microbiome, along with an increase in bacterial translocation to extra intestinal sites that originated from the gut. This suggests that burn injury promotes a dysregulation of the gut microbiota leading to bacterial translocation, which plays a significant role in post-burn inflammation and risk of sepsis. Thus, these results may modify treatment for severe burn patients in order to restore the homeostasis of the gut microbiome, reducing the risk of complications following thermal injury.

O10
Aberrant TGFβ Responses in Post Epithelial-Mesenchymal Transition Cancer Cells

Presenter(s)
August Nagro, Illinois Mathematics and Science Academy

Advisor(s)
Paul Grippo, University of Illinois at Chicago

Pancreatic adenocarcinoma ranks as one of the most lethal cancers in the United States, with a five-year survival rate of 6-7%. Recent therapeutic efforts have focused on inhibiting transforming growth factor beta (TGFβ) given its tumor-promoting effects in the cancerous microenvironment. TGFβ elicits different reactions in different tissues, however, and the reaction that induces epithelial-mesenchymal transition (EMT) in epithelial cells may affect TGFβ inhibition. To study the effects of TGFβ on mesenchymal-like epithelial cells, PanIN KC4848 cells were cultured *in vitro* and EMT was induced with five successive applications of 10 ng/ml recombinant TGFβ1 every other day. Interestingly, the mesenchymal-like PanIN cells proliferated in the presence of TGFβ whereas the unmodified PanIN control experienced growth-arrest. After the post-EMT PanIN cells were allowed to return to a more normal epithelial phenotype, the cells exhibited a more typical response to TGFβ, again consistent with cell cycle arrest. These findings suggest divergent TGFβ signaling pathways in pre- and post-EMT epithelial cells, and imply that EMT status may be relevant in predicting efficacy of therapeutic strategies targeting the TGFβ pathway.

O11
Bacterial Coinfection and Antimicrobial Resistance in Patients With Viral Community-Acquired Pneumonia

Presenter(s)
Eleanor Naudzius, Illinois Mathematics and Science Academy

Advisor(s)
Jeffrey Semel, Northshore University HealthSystem

Pneumonia can present itself in various forms and lead to a variety of outcomes, many of which depend on the etiology of the pneumonia. Past studies suggest viral-bacterial pneumonia coinfection often result in complications in treatment and a poor prognosis, such as in the 1918 and 2009 influenza epidemics. I decided to evaluate the relationships between viral and bacterial pneumonia coinfection from an epidemiological perspective in the Northshore Healthcare system. I received data on 197 patients with viral pneumonia, eight of whom obtained a coinfection, with a coinfection rate of 4.06%. Of these patients, 50% had an infection with *Streptococcus pnuemoniae*, and 25% had an infection with *Corynebacteria*. Overall, patients with a coinfection had a better prognosis than patients with viral pneumonia, though patients with a coinfection had a statistically significant longer length of stay. Males had a relative risk of 7.36 of attaining a coinfection. The coinfection rate at Northshore Healthcare is significantly lower than the rate established by previous studies. The low coinfection rate indicates that patients can have antibiotics stopped early with observation and laboratory study. Since patients were not selected based on the severity of their illness, my results differ greatly from previous studies.

O12
Analysis of the Immune Response to Methicillin Resistant *Staphylococcus aureus* Surface Proteins FnBPA, ClfA, SdrE, and SdrD for Vaccine Development

Presenter(s)
Keelyn O'Brien, Illinois Mathematics and Science Academy

Advisor(s)
Lukasz Sewera, Loyola University Chicago
Chris Wiethoff, Loyola University Chicago

The methicillin resistant strain of the bacteria *Staphylococcus aureus* (MRSA) normally causes a mild skin infection, but when these bacteria enter the blood stream, MRSA can cause life-threatening illness. Key to the virulence of the bacteria is the abundance of cell surface proteins, which are essential for cellular adhesion, invasion, and evasion of the immune response. First, we purified domains from the MRSA surface proteins FnBPA, ClfA, SdrE and SdrD. We then analyzed the immune response to these surface proteins using Western blotting and enzyme-linked immunosorbent assays (ELISA). We performed ELISAs to compare antibody titers in mice that had been inoculated directly with the purified bacterial proteins to those that had been inoculated with a prepared adenovirus vaccine that had the bacterial proteins cloned into it. The results will show if the adenovirus vector is an effective vaccine method. As MRSA strains become more prevalent and develop a resistance to an increasing number of antibiotics, it is important to be able to vaccinate people against MRSA. The potential for vaccine development using the surface proteins FnBPA, ClfA, SdrE, and SdrD delivered via an adenovirus vector could result in an effective, safe vaccine against MRSA.

O13
Glioblastoma Multiforme Induces Immunosuppression via Regulatory T cells, PDL1, and CTLA4

Presenter(s)
Aadit Shah, Illinois Mathematics and Science Academy

Advisor(s)
Leonel Ampie, Northwestern University
Winward Choy, Northwestern University
Shayan Fakurnejad, Northwestern University
Andrew Parsa, Northwestern University

The diagnosis of glioblastoma multiforma (GBM) portends a poor prognosis due to its rapid growth rate and limited therapeutic options. Current research is focused on utilizing the patient's immune system to counteract this aggressive tumor. However, this approach is flawed as GBM patients suffer from the immunosuppressive properties of the tumor itself. To further understand this phenomenon, first a series of immunohistochemistry tests were conducted on resected tumor tissue to detect the presence of regulatory T-cells, PDL1, and CTLA4. After which, a series of flow cytometry tests were performed on the tumor infiltrative leukocytes (TILs) and the peripheral blood leukocytes (PBLs) taken from patient specimens to assess the level of expression of these immunosuppressive factors. This study determined that there was a statistically higher presence of these immunosuppressive signals on TILs relative to PBLs ($p<0.00001$). Thus, it demonstrates a greater expression of the aforementioned markers within the glioblastoma microenvironment. This allows us to further understand the implications of this immunosuppressive phenomenon in light of upcoming clinical trials focused on allowing GBM patients to naturally suppress cancer recurrence after surgery.

O14
Toxicity of Oxaliplatin Resulting in Peripheral Sensory Neuropathy Detected Through Nerve Conduction Studies and Needle Electromyography

Presenter(s)
Mitchell Sun, Illinois Mathematics and Science Academy

Advisor(s)
Susan Lis, Advocate Lutheran General Hospital
David Ronin, Advocate Lutheran General Hospital

Rectal cancer is the third leading cause of death in America. A combination of oxaliplatin, 5-fluorouracil, and leucovorin (FOLFOX) is a common treatment for rectal cancer but is limited by neurotoxicity. We describe a case of a young woman who has weakness in her extremities following surgery and FOLFOX treatment. The needle electromyography and nerve conduction studies of the patient were reviewed, showing no response in the median, ulnar, radial, and sural sensory nerves and the motor unit potentials revealed polyphasicity and spontaneous repetitive discharge of vastus lateralis. This was consistent with oxaliplatin-induced peripheral axonal sensory neuropathy. An additional neuropathy of the right femoral nerve was most likely caused by a complication during surgery. A literature search was performed to review the pathophysiology of neuropathies secondary to oxaliplatin. Based on this case study, a surveillance program and education system should be set up to review patients prior to receiving treatment and during treatment of oxaliplatin. This will enhance our knowledge of oxaliplatin-induced peripheral axonal sensory neuropathy mechanisms. Studies would be beneficial to further elucidate prevention and treatment of oxaliplatin-induced neurologic complications.

Neurobiology

P01
Use of a Novel Magnetic Resonance Imaging Compatible Head-Positioning Device for Three-Dimensional Kinematic Analysis of the Cervical Spine in Axial Rotation

Presenter(s)
Jyotsna Bitra, Illinois Mathematics and Science Academy
Jessica Phung, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University
Kenneth Weber, Northwestern University

Few studies have dealt with three dimensional *in vivo* images of the cervical spine during head rotation because of the difficulty of measuring coupled motions. Our project investigates the coupling measures using magnetic resonance imaging in six healthy cervical spines and three patients with neck pain. Subjects were scanned in three different positions, neutral and 40° left and right. We then calculated the coupling measures. Total average axial rotations were 34.77° (± standard deviation 13.75°) left rotation and 41.27° (± standard deviation 6.48°) right rotation for healthy subjects and 41.17° (± standard deviation 2.12°) left rotation and 30.47° (± standard deviation 7.90°) right rotation for neck pain patients, respectively; there was no significant difference between groups ($p > 0.05$). Between groups, significant differences were found in flexion and extension at C1-C2 ($p < 0.05$), and in left-right translation at C6-C7 ($p < 0.01$). We found that neck pain subjects had lower axial rotation which was expected. Due to the small sample size of this investigation, it is difficult to make any generalizations but with a larger sample size, this investigation could be very useful to identifying spinal pain because of its relevance to modern treatments.

P02
Gray Matter Volumes in Glioblastoma Multiforme Patients Using Structural Imaging

Presenter(s)
Lauren Bystrom, Illinois Mathematics and Science Academy
Hanna Flatness, Illinois Mathematics and Science Academy

Advisor(s)
Lei Wang, Northwestern University
C. Paula de los Angeles, Northwestern University

Glioblastoma multiforme (GBM) has one of the worst prognoses of five year survival rates and is also the most common and most malignant primary tumor of the brain. Structural magnetic resonance imaging scans from seventy-nine patients were analyzed using FreeSurfer to develop a variety of corresponding data points. Using these data points we found a positive correlation between Karnofsky Performance Status, a test done at diagnosis to determine functional impairment and days of survival. On further investigation, we found that our results supported previous studies. One of the results we found particularly astounding was a negative correlation between days of survival and the volume of the hippocampus. From this we can determine that the volume of the gray matter in the different parts of the brain does have a significant impact on the long term survival of GBM patients.

P03
Altered Brain Activity Between Language Tasks Project How Individuals in a Minimal Conscious State Process Language

Presenter(s)
Kristin Carlson, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University
Xue Wang, Northwestern University

Wernicke's area serves as the junction of temporal, parietal, and occipital lobes in the brain and controls the humans' ability to process language. Functional magnetic resonance imaging (fMRI) scans show the activation of Wernicke's area and other language processing centers of the brain during the performance of language tasks. In this study, three participants with normal brain activity received fMRI scans throughout the duration of three tasks that lasted eight minutes each. The tasks consisted of pairs of synonyms, unrelated words, identical tones, and different tones. In the first task individuals listened to the word list without instructions, in the second task participants identified the synonyms and identical tones without response, and in the third task the subjects responded to each synonym pair or identical tones with the press of a button. The results showed that the second and third tasks caused significantly more activation of language processing networks, but the first task did show some activation of language centers. These findings support the hypothesis that individuals in a minimally conscious state have the ability to process language and allow the procession of a study that compares how individuals in a coma and individuals with normal brain activity process language.

P04
Involvement of mGluR5 and MOR Heterodimers as Novel Targets to Treat Alzheimer's Disease

Presenter(s)
Greeshma Chilukuri, Illinois Mathematics and Science Academy
Sameeksha Malhotra, Illinois Mathematics and Science Academy

Advisor(s)
William Klein, Northwestern University
Kirsten Viola, Northwestern University

Alzheimer's disease is the sixth leading cause of death in the United States, and currently has no cure. Its pathogenesis is induced by amyloid beta oligomers, which over activate nerve cells, leading to cell death and memory loss. This investigation focused on the involvement of two receptors, the metabotropic glutamate receptor 5 (mGluR5) and the mu opioid receptor (MOR), as novel targets to treat Alzheimer's disease. The presence of a complex between these two receptors was identified through coimmunoprecipitation, as well as a Western blot, which determined the molecular weights of both the receptors. Moreover, tau phosphorylation, a hallmark of Alzheimer's disease, was induced in cells with the agonist of MOR, suggesting that activating the receptor MOR progresses pathogenesis of this disease. Cells with amyloid beta derived diffusible ligands (ADDLs) also showed higher MOR activation through ADDL straining techniques, confirming the presence of ADDLs in the MOR-mGluR5 complex. In the future, the presence of this complex can lead to the development of drugs targeting MOR and mGluR5, which will inhibit the pathogenesis of Alzheimer's disease.

P05
Effect of Varying Musical Stimuli on Memory Recall

Presenter(s)
Gloria Choi, Illinois Mathematics and Science Academy
Kirstin Johnson, Illinois Mathematics and Science Academy

Advisor(s)
Elise Gagnon, Northwestern University
Joel Voss, Northwestern University

Previous studies have shown that studying while music is playing can disrupt learning. In our investigation we researched the effects of musical stimuli on memory recall of individuals. The primary goal was to test whether familiar or unfamiliar musical stimuli had a greater effect on memory recall. Adolescents and adults ages 15-30 were tested in a behavioral chamber with a computer monitor. In each test, subjects were presented with one-hundred images of common objects while either familiar or unfamiliar music played in the background. Our subjects were then asked to respond whether the image had been shown in the previous test or not, by clicking the buttons 1 and 2 respectively, to 100 different images while familiar music played in the background. The ability to discriminate old from new images was quantified using the D-prime statistic comparing the familiar and unfamiliar music condition using an F test. On average, the D-prime for familiar music was 0.58 and the D-prime for unfamiliar music was 0.63. These preliminary statistical analyses of accuracy data suggested that test results from the familiar music fared less accurately than test results from unfamiliar music. We conclude that the familiarity of musical stimuli is associated with memory recall and learning development.

P06
Differentiation of Angiomatous and Non-Angiomatous Meningiomas Using High b-Value Diffusion Imaging With a Fractional Order Calculus Model

Presenter(s)
Nicholas Damen, Illinois Mathematics and Science Academy

Advisor(s)
Frederick Damen, University of Illinois at Chicago
Yi Sui, University of Illinois at Chicago
Xiaohong Joe Zhou, University of Illinois at Chicago

Angiomatous meningiomas, a subtype of grade I meningiomas, have the highest recurrence rate of all benign meningiomas, and also recur as higher malignant tumors. The purpose of this study was to differentiate between angiomatous meningiomas and non-angiomatous meningiomas using datasets analyzed from a combination of fractional order calculus model and intravoxel incoherent motion model. Thirteen patient datasets were collected and analyzed. Regions of interests (ROI) were drawn over intracranial lesions. The variables D0 (apparent diffusion coefficient), beta (homogeneity of tissue), signal on high b-values, and fractional flow (Ff), that describe properties of meningiomas, are used distinguish differences between angiomatous and non-angiomatous. A Mann-Whitney U-test was used to analyze the ROI information of each intracranial lesion. The difference of Ff between angiomatous and non-angiomatous meningiomas is statistically significant ($P < 0.05$). By using a fractional order calculus model to analyze the datasets, Ff is able to differentiate between angiomatous and non-angiomatous meningiomas.

P07
Automatic Lesion Segmentation: Applying Mean Shift Clustering and Brain Symmetry

Presenter(s)
Grace Duan, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University
Bao Wang, Northwestern University
Xue Wang, Northwestern University

Hand-drawn lesion delineation is the gold standard, but is tedious and operator-dependent. This investigation tests a novel method of automatic lesion segmentation in magnetic resonance imaging that incorporates mean shift clustering and brain symmetry. After organizing fifty-nine lesion data sets from various sites, information about the T1 images and lesion masks were gathered and inputted into three Matlab wrappers following a pipeline of morphological skull stripping, mean shift clustering, and application of brain symmetry. The resulting images are then compared to the gold standard lesion masks, producing an average Dice value. Each lesion is run multiple times with different parameters, eventually saving the one producing the highest Dice value. The average Dice value across the fifty-nine data sets is 0.54. Excluding the data sets with Dice values of zero, the average of the forty-eight remaining is 0.66. Like previous attempts, this method of automatic lesion segmentation performs the best on lesions that are larger and located away from the ventricles and brain contours. The relatively accurate results generated on larger lesions can potentially revolutionize lesion identification in chronic stroke patients. This algorithm, if improved further, can have clinical and research applications by its objectification of the lesion identification process.

P08

Active Brain Regions During Sleep Using Electroencephalography-Functional Magnetic Resonance Imaging

Presenter(s)
Grace Duan, Illinois Mathematics and Science Academy
Sameeksha Malhotra, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University

With techniques allowing the simultaneous acquisition of electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI) data, active brain regions during different stages of the human sleep cycle were determined. Data were collected using a Siemens 3T Trio magnet with standard BOLD sequence acquired for 45 minutes while the subject slept and Neuroscan Maglink MRI-compatible EEG. The EEG data oscillations were used to segment the sleep into the five sleep stages. The respective magnetic resonance images were grouped, motion corrected, and spatially smoothed. Regions of interest (ROIs) were extracted to create correlation maps and visualized using Mango software. Correlation matrices were created using MATLAB displaying neuronal connectivity among ROIs. Results suggest that ROI brain activity is localized during sleep stage two. In rapid eye movement (REM) sleep, ROI brain activity is also present in most other brain regions. Hippocampal activity is most prevalent in all investigated stages, followed by thalamus, posterior cingulate, and amygdala activity. Brain activity in stage one and REM is similar, although REM activity is less concentrated to the ROI. The correlation matrix results are consistent with the qualitative analysis. EEG-fMRI data can lead to an improved understanding of brain activity during sleep, which may help in diagnosing sleep disorders.

P09

Determining Offset Analgesia With Dual Stimuli Applied to Opposite, Proximal, and Distal Locations

Presenter(s)
Sarah Eaton, Illinois Mathematics and Science Academy

Advisor(s)
Vania Apkarian, Northwestern University
Bogdan Petre, Northwestern University

Offset analgesia (OA) occurs when the intensity of an ongoing painful stimulus is minimally reduced, which causes the magnitude of pain perception to be substantially, but briefly, decreased. Current research is being done with single thermodes to determine if OA occurs in the brain. The use of dual thermodes in this experiment was to see if OA is controlled by the central nervous system (CNS) or peripheral nervous system. This investigation used dual heat stimuli on the forearms, proximally or distally from each other or on opposite arms, with a temperature intensity and pain magnitude continuously measured to determine the extent of analgesia. Single stimulus OA was compared to dual stimulus OA and a control block of constant temperature took into account the participants' normal variability in rating their pain. Results indicate the application of distal and proximal stimuli produce OA since there is a significant difference between them and the control block. However, the planned test comparing the similarity between single stimulus OA and dual stimulus OA were inconclusive, but trended towards being similar. If more data were to be collected and they were similar, this could show OA is controlled by the CNS, since OA is produced even though different peripheral neurons are being stimulated by the dual stimuli. While we would not know if it's controlled by the spinal cord or brain specifically, we would know OA is a central response.

P10
Amyloid Precursor Protein and Amyloid-β Oligomer Concentrations are Connected in Developing Chicken Embryos

Presenter(s)
Nathan Errampalli, Illinois Mathematics and Science Academy
Michael Qian, Illinois Mathematics and Science Academy

Advisor(s)
Sydney Doe, Northwestern University
William Klein, Northwestern University
Kirsten Viola, Northwestern University

One of the major hallmarks of Alzheimer's disease (AD) is the presence of amyloid-β oligomers (AβO) in the human brain. Although the status quo is to use transgenic mice for modeling AD, chicken embryos are less costly, and the Aβ peptides in chicken are identical to that in humans, a trait that rodents do not have. In our study, the relationship between avian brain amyloid precursor protein and AβO concentrations throughout the chicken embryo's development were examined from E6-E14. Eggs were grown with an incubator, and embryos were dissected for their brains when grown to the desired age. Each sample was homogenized, and bicinchoninic acid assays were performed to determine each samples' overall protein level. Samples were diluted to the same concentration to allow for dot blot assays to be conducted to assess their concentrations of APP and AβO. Results show that the correlation between amyloid precursor protein and AβO is statistically significant ($p < 0.01$), with concentrations increasing until day 9, followed by continual decrease. Because of this, this model seems to have potential to be used for observing the effects of Aβ toxicity and drug testing. More knowledge on this system will allow for increased research usage with this cost-effective model.

P11
The Effects of Functional Electrical Stimulation on Hand Control

Presenter(s)
Zeidy Garcia, Illinois Mathematics and Science Academy

Advisor(s)
Jun Yao, Northwestern University

It is common for post stroke survivors to have reduced voluntary hand control. A newly developed electromyography-triggered functional electrical stimulation system, ReIn-Hand, was used to regain voluntary hand opening in individuals with stroke. Two severely impaired stroke individuals were recruited for a fifteen to twenty-two session intervention, three sessions per week. Both subjects have lost voluntary hand control, and suffer from abnormal muscle coupling. Subject one also has sensory impairment and spasticity, whereas subject two suffers from muscle weakness. In each training session, subjects repeated reaching, grasping, and releasing tasks using the paretic arm with the assistance of ReIn-Hand. Sensorimotor impairment and active range of motion were measured before and after the intervention. By the end of the intervention, both subjects reported improved sensory feedback, reduced muscle tone, as well as increased voluntary index finger extension at metacarpophalangeal joint (subject 1 from -45° to -19°, and subject 2 from -20° to +11°, with positive and negative means extension and flexion angle, respectively). Subject two also reported significant improvements in functional usage of the affected hand. These results suggest that the practice with ReIn-Hand is efficient and improved use of the paretic hand may be found with further investigation.

P12
Effects of Acute Ethanol Exposure on the Expression of the Gamma Amino Butyric Acid Receptor Subunits in Rat Cortex

Presenter(s)
Rajangad Gurtatta, Illinois Mathematics and Science Academy

Advisor(s)
Subhash Pandey, University of Illinois at Chicago
Tara Teppen, University of Illinois at Chicago

The anxiolytic effect of ethanol plays a crucial role in the development and maintenance of alcohol addiction. Acutely, ethanol has been shown to enhance gamma amino butyric acid-A (GABA-A) neurotransmission in the brain, however the effects of anxiolytic doses of ethanol on the expression of GABA-A receptor subunits are relatively unexplored. We first designed the primers and established the procedure of quantifying the expression of various subunits of GABA-A (α1, α4, α5, and δ) using the methods of reverse transcription and quantitative real-time polymerase chain reaction. It was observed that acute ethanol exposure (1 g/kg intraperitoneal) was not able to modify the mRNA expression of the α1, α4, α5, or δ subunits of the GABA-A receptor in rat cortex. Although the results are preliminary in nature, they suggest that the anxiolytic action of alcohol may be mediated by post-translational modifications of GABA-A subunits rather than changes in gene expression. The findings from this experiment are applicable in understanding the anxiolytic effects of alcohol exposure not via changes in the gene expression but most likely by functional changes in GABA-A receptors.

P13
Role of Oligodendrocytes in Ischemic Brain Repair

Presenter(s)
Cindy Ho, Illinois Mathematics and Science Academy

Advisor(s)
Richard Miller, Northwestern University

The brain has very limited abilities to repair itself after trauma as nerve cells lose their mitotic apparatus, preventing cell division after 6 months of age. However, oligodendrocytes, with their ability to produce myelin sheaths, have the potential to assist in neuron regeneration after brain damage. Using NG2 mice which have oligodendrocyte precursor cells stained red, oligodendrocyte activity can be studied from 2, 3, and 4 weeks after an induced ischemic stroke using the medial carotid artery occlusion method. After perfusion with phosphate buffered saline, brains were sliced into 40 micron sections, immunolabeled, and prepared for viewing under a confocal microscope (FV10i). Oligodendrocytes were counted in the area of the induced stroke of the affected hemisphere and the contralateral side on the opposite hemisphere. Preliminary results suggest that the highest oligodendrocyte upregulation occurs during the period 3 weeks after stroke with a sharp decrease in number by 4 weeks, which is prevalent at the peri-infarct zone. Results of this study demonstrate possible involvement of oligodendrocytes in neural repair after ischemic stroke and thus help us to extend our knowledge for mechanism and treatments for neurodegenerative diseases.

P14
Eye Tracking, Pulmonary Tracking, and Heart Rate Tracking Using Various Stimuli

Presenter(s)
Kirstin Johnson, Illinois Mathematics and Science Academy

Advisor(s)
Moran Cerf, Northwestern University

Neuromarketing is a field of research which looks into consumer responses to various marketing stimuli. Research shows a correlation between marketing format and the natural reactions of both male and female subjects. The goal of this investigation was to determine what specific factors induce stronger reactions from people. In order to determine this, we interviewed and collected data on twenty-eight males and twenty-eight females. We hooked up each volunteer to an electroencephalograph scanner, a pulmonary tracker, and a heart rate monitor, and then videotaped them while tracking eye movement as they watched trailers and a movie at American Multi-Cinema Theaters. Afterwards, we interviewed them to test information recall and had them complete a summary of the movie. Our results showed that eye movement patterns were 25% more rapid different during engaging movie trailers (for example, *3 Days to Kill*) rather than nonengaging trailers (for example, *Noah*). Engagement levels were measured using previous reviews. Pulmonary tracking and heart rate showed an increase during engaging scenes, and a decrease in nonengaging ones.

P15
Investigating the Functional Properties of PD-L1 in Mice Glioblastoma Multiforme

Presenter(s)
Abrar Khaja, Illinois Mathematics and Science Academy

Advisor(s)
Shayan Fakurneja, Northwestern University
Rajwant Kaur, Northwestern University
Andrew Parsa, Northwestern University

Prior studies have shown increased presence of the programmed death ligand-1(PD-L1) protein in many cancer cells including many glioblastoma cell lines. This protein is thought to be a powerful immunosuppressant, capable of deactivating a host's immune system to prevent immunodestruction. This study presents a systematic analysis of the protein via gene knockout, and assesses the proteins potential as either a growth factor signaling for cell proliferation or an invasion protein causing metastasis of the tumor and promoting angiogenesis. The cells were divided into three groups, one wild type GL261 glioblastoma cell line, a PD-L1 knockout, and a negative control using a scrambled viral vector. By doing multiple cell proliferation counts between the different groups of cells, it was determined that PD-L1 was most likely not signaling the cell to continue dividing. This was shown by the non-significant differences in normalized values between cell lines expressing PD-L1 and the wild type cells. An invasion assay was also done to measure cell migration between the three groups which yielded statistically insignificant differences. This gives more support to the argument that PD-L1 does not affect the invasion potential of a tumor cell or its cell proliferation but may still aid it in immunomodulation.

P16
The Effect of Antipsychotic Risperidone Treatment on Neuroanatomical Volumetric Deformations in Rats

Presenter(s)
Joshua Kleinman, Illinois Mathematics and Science Academy

Advisor(s)
Kate Blizinsky, Northwestern University
Ashley Walters, Northwestern University
Lei Wang, Northwestern University

Risperidone is a second-generation antipsychotic drug used to treat schizophrenia, a long-term debilitating mental disorder characterized by symptoms of visual and auditory hallucinations, social reclusion, and cognitive deficits. Antipsychotic treatments have been shown to result in differential volumetric aberrations in humans and animal models. This investigation explores the influence of risperidone treatment on total and regional brain volumes in Long-Evans rats treated with various dosages of risperidone. Magnetic resonance images (MRIs) of the rats were taken after 29 days of treatment. To analyze total and regional brain volumes, we isolated the brain tissue from the skull in the MRIs in a procedure called skull stripping. Then, we aligned the skull stripped brain to a template image, an MRI of the Paxinos atlas. After alignment, we back-projected the atlas onto the aligned image to segment the brain into various regions of interests, and we found the volumes of those regions by running voxel counting commands. The results showed that risperidone had neither a significant impact on the total brain volume between dosage groups nor a significant impact on sub-regional volumes. This information can help physicians perform risk-benefit analyses and researchers understand neuroanatomical implications of antipsychotic treatments.

P17
Using Functional Connectivity in the Basal Ganglia as a Biomarker for Parkinson's Disease

Presenter(s)
Neal Modi, Illinois Mathematics and Science Academy
Tian Lin Yuan, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University

Parkinson's disease (PD) is a chronic movement disorder that occurs when nigrostriatal dopaminergic neurons within the basal ganglia network (BGN) are damaged or destroyed, causing motor and cognitive disabilities. Motor disabilities can be measured by the Unified Parkinson's Disease Rating Scale (UPDRS-III). PD currently has no cure, so the discovery of a biomarker is vital for successful clinical trials and accurate early diagnosis. This study looks at the potential of using functional connectivity in the BGN as a biomarker for symptoms of PD. Data from seventy subjects were downloaded from the Parkinson's Progression Markers Initiative Database and analyzed for functional connectivity values using a seed-based method. The values were correlated with UPDRS-III scores, taking into consideration the effects of age, site, education, and gender. There was a significant correlation between functional connectivity between the left and right caudate and the UPDRS-III subscore for rigidity. Patients with reduced connectivity received higher rigidity scores, demonstrating a more severe case of PD. Thus, results from this study indicate the potential for functional connectivity within the basal ganglia to serve as a biomarker for the progression of specific symptoms of PD.

P18
Examining the Specificity of N-Methyl-D-Aspartate 2B Receptor Targeted Primary Antibodies Using Fluorescent Microscopy

Presenter(s)
Naima Muckom, Illinois Mathematics and Science Academy

Advisor(s)
Amanda Gross, Northwestern University
Roger Kroes, Northwestern University
Joseph Moskal, Northwestern University

The N-methyl-D-aspartate receptor (NMDAR) plays an important role in development. The purpose of this investigation was to determine the best primary and secondary antibodies for the detection of NMDAR2B. We measured the specificity and the intensity of bound antibodies using human embryonic kidney cells that contained only NMDAR2B. Our results showed that the antibody made by Cell Signaling was the most specific while the antibody made by Abcam had the highest intensity. The antibody made by Cell Signaling would be the better antibody in this case because while the Abcam antibody showed higher fluorescence intensity, it targeted other NMDAR subtypes than NMDAR2B. If the Abcam antibody were used in an experiment, it would skew the results because it would suggest that there is more NMDAR2B than is actually present. Because of this, specificity is more important than intensity, making the Cell Signaling antibody the better antibody to use for targeting NMDAR2B.

P19
The Effects of Menadione on Cancer Cell Metabolism and Mitochondrial Health

Presenter(s)
Charmaine Ong, Illinois Mathematics and Science Academy

Advisor(s)
David Braun, University of Illinois at Chicago
Douglas Feinstein, University of Illinois at Chicago

Menadione, also known as vitamin K3, is a synthetic quinone derivative that has cytotoxic effects and is currently under investigation as a potential adjunct cancer treatment. Some evidence indicates that toxicity may be due to the production of reactive oxygen species. However, effects on mitochondrial function are not well characterized. Here, we explore menadione toxicity on various human and rodent cancer cell lines, and measure the effects on multiple parameters of cellular and mitochondrial viability. Increasing concentrations of menadione were added to human and rodent glioma and epithelioma cells for varying amounts of time. Lactate release, an indicator of glycolysis and indirect measure of mitochondrial dysfunction, was measured with a colorimetric assay after 60 and 180 minutes of treatment. Mitochondrial damage was directly assayed with the fluorescent JC-1 dye, which measures mitochondrial membrane potential. Lactate release was prevented in a concentration dependent manner in both human and rat cell lines, coinciding with increased mitochondrial damage as assessed by JC-1. These data indicate that, in addition to oxidative damage, menadione may be directly interfering with glycolytic metabolism, a pathway on which cancer cells heavily depend. Further, menadione appears to directly affect mitochondrial membrane integrity, which may further contribute to cell death.

P20
Changes in Resting State Functional Connectivity in the Default Mode Network From Chemotherapy-Induced Cognitive Impairment in Breast Cancer Patients

Presenter(s)
Khusbu Patel, Illinois Mathematics and Science Academy

Advisor(s)
Alexandra Apple, Northwestern University
Lei Wang, Northwestern University

Chemotherapy-induced cognitive impairment, or chemobrain, can result in changes in memory, attention, and motor skills in cancer patients. These impairments can be short-term or affect patients for the rest of their lives. Previous studies have shown that functional connectivity is heightened in the default mode network (DMN) for diseases like schizophrenia and Alzheimer's disease. Therefore, we hypothesized that this change may be present in chemobrain. Collecting resting state functional magnetic resonance imaging (rsfMRI) data can provide insight for the effects of chemobrain on the DMN since it activates when the brain is not focused on a specific task. Thus, to test our hypothesis, we scanned thirty-three breast cancer patients and two healthy subjects. Then, we compared DMN functional connectivity in breast cancer patients and matched normal patients. Our preliminary results suggest that there is increased DMN functional connectivity in breast cancer patients, which would indicate that there is a link between chemobrain and other neurodegenerative diseases. This investigation is ongoing; thus, more significant results are dependent on completing these analyses in the near future and scanning more control patients.

P21
The Impact of Traumatic Brain Injury on the Morphology of Mouse Astrocytes

Presenter(s)
Ahsan Qureshi, Illinois Mathematics and Science Academy

Advisor(s)
C. Savio Chan, Northwestern University
Jason Pitt, Northwestern University

Traumatic brain injury (TBI) occurs when an impact is registered on the brain. TBI impairs cognitive function and can result in death due to toxic effects on brain cells, such as neurons. Neuronal function is supported by a type of glial cell called the astrocyte, which extends a number of cellular processes to contact and communicate with neurons, synapses, and the cerebral vasculature. Although astrocytes are altered in TBI, it is not yet known to what degree their function changes and how this affects the viability of neurons. In this investigation, mice were subjected to two types of traumatic brain injury, controlled cortical impact and blast injury, in order to determine the effect TBI has on astrocyte morphology. Astrocytes in acute mouse brain slices were then filled with a fluorescent dye and manually reconstructed in ImageJ. Astrocyte morphology was compared between our two types of TBI and a control model using Sholl analysis. The factors that were examined were cell body size, and the complexity of cellular processes (that is, total length and branch points). We expect that TBI will reduce the complexity of astrocytic processes, which could impair communication with neurons and perhaps explain the neuronal deficits observed in TBI.

P22
Statistical Differences in the Resting State Network of Iraqi Veterans and Former National Football League Players

Presenter(s)
Malavika Ramnath, Illinois Mathematics and Science Academy

Advisor(s)
Todd Parrish, Northwestern University

In mild traumatic brain injury (mTBI) affected patients, certain regions of the brain that control reasoning and decision-making can be adversely affected. However, it is unclear what the long term effects of an mTBI injury are on patients. This investigation compared the resting states of two experimental groups who had suffered traumatic brain injuries in the past against a normal control group. Working with previously collected data of nine ex-National Football League players and Iraqi war veterans, these groups were specified as those with mTBI only, and those that were diagnosed with a mental health disorder (MDH). Twelve regions of interest (ROI) were identified, and both the functional and structural connectivity between the ROIs were examined. Diffusion tensor imaging results were used to examine structural connectivity qualitatively using mean diffusivity and fractional anisotropy. The functional connectivity used correlation matrices and brain connectivity maps to examine the communications between hemispheres. The functional connectivity analysis results indicated that the corpus callosum remained intact in the mTBI only patients, with evidence of upregulation, a higher interaction between the two hemispheres after the injury. The study essentially compares the effects of only mTBI injuries to those that also have MDH, which has strong societal implications.

P23
An Electrocorticographic Study of Cerebral Activation During Moral Judgments

Presenter(s)
Rashmi Thimmapuram, Illinois Mathematics and Science Academy

Advisor(s)
Vernon Leo Towle, University of Chicago

Moral judgement and decision-making are associated with activation of certain brain regions as identified in functional magnetic resonance imaging (fMRI) and clinicopathologic studies. These include the posterior superior temporal sulcus, amygdala, and the ventromedial prefrontal cortex. Unfortunately, fMRI has poor temporal resolution. In an attempt to describe the temporal sequence of cognitive events, we obtained electrocorticographic recordings with millisecond resolution from seven epileptic patients undergoing surgical work-up for intractable seizures. The activation of the brain was mapped out over time for the brain regions specified above when the patient viewed three different triplets of images depicting 1) accidental harm, 2) attempted harm, and 3) intentional harm. We analyzed five frequency bands containing delta, theta, alpha, beta, and gamma frequencies and found that there was activation in the right orbital frontal cortex, middle temporal gyrus, and inferior temporal region. Middle temporal gyrus activation has not previously been described with this paradigm. No patient showed activation in all three areas, which precluded evaluation with inferential statistical tests. A better understanding of how the human brain evaluates moral situations could potentially be useful in the treatment for patients with sociopathic disorders.

P24
Correlation of Memory Dysfunction and Aβ Build-Up in an Alzheimer's Disease Transgenic Mouse Model

Presenter(s)
Jason Wu, Illinois Mathematics and Science Academy

Advisor(s)
William Klein, Northwestern University
Kirsten Viola, Northwestern University

A basis for memory failure in Alzheimer's disease (AD) has been associated with small, soluble amyloid β-peptide oligomers (AβOs), a toxin commonly regarded as a cause of neuronal damage and an inhibitor of long-term potentiation in the hippocampal region of the brain. Synapse loss and memory failure in transgenic mice models have shown that there is a possible correlation between AD dementia and the build-up of amyloid plaques. It is possible to test for comprehensive functionality in mouse models, that is, learning and memory in the hippocampus, using behavioral assays. The open field novel object recognition tests assess memory and learning behavior in the mouse models used for this investigation - 5xFAD mice that express five Alzheimer's disease related mutations. Upon analyzing the videos, the mice were then sacrificed and their brains were halved for histochemical analysis and immunofluorescent labeling to detect oligomeric plaques. Preliminary results suggest that there is indeed a significant correlation between behavior and memory loss in the transgenic mice; these are currently being confirmed. The evidence has thus established that the oligomeric hypothesis is an appealing molecular basis for AD and the build-up of Aβ oligomers in the hippocampal region seems to result in memory loss.

Physics

Q01
Quantifying the Effects of the Ionization Detector on the g-2 Magnet's Magnetic Field

Presenter(s)
Niharika Agrawal, Illinois Mathematics and Science Academy

Advisor(s)
Brendan Kiburg, Fermi National Accelerator Laboratory
Mandy Rominsky, Fermi National Accelerator Laboratory

Muons are unstable, subatomic particles that are similar to electrons, but are two hundred times more massive. Ionization detectors track the electrons that rise from decayed muons. We used the program OPERA-3D to create a computer simulation of both the ionization detectors and the magnet. We graphed the external magnetic field while using different materials for the detector to see differences in the field. Results have shown a significant change in the uniformity of the magnetic field when comparing steel, iron, and aluminum detectors. Preliminary results show that using aluminum for the detector at a distance of five centimeters from the center axis of the magnet will not cause a significant change to the uniformity of the magnetic field. The research conducted will allow the project to continue implementing the detector design as planned within the g-2 project.

Q02
The Effect of Shear to Bulk Modulus Ratio on the Crumpling of a Sheet

Presenter(s)
Vikram Anjur, Illinois Mathematics and Science Academy

Advisor(s)
Irmgard Bischofberger, University of Chicago
Sidney Nagel, University of Chicago

Across a myriad of materials ranging from soda bottles to freight ships, the malleability and durability of goods have prompted numerous studies on the structural stability of elastic substances like sheets. This study investigates the effects of G/B (shear over bulk modulus) on a sheet's rigidity and response to an applied stress. Sheets composed of hexagonal patterns, whose G/B ratios can be easily modified, are designed in Python and AutoCAD and made from a polydimethylsiloxane polymer. When these lattices are compressed, a ridge forms horizontally. We then use a rheometer to measure the applied force as the ridge is compressed vertically. This measurement reflects the sheet's strength and its resistance to crumpling. To decouple the contributions from changes in G/B with those from changes in the sheet's density ratio (volume of polymer over volume of air) in our data, we repeat the same process for triangular lattices, whose G/B remains nearly constant but whose density ratio changes. Preliminary results indicate that lowering G/B does lower a sheet's resistance to crumpling. We find that the amount of force needed to compress the sheets exhibits an intriguing plateau at intermediate distances, whose origin we plan to uncover in future studies.

Q03
Causes of Cosmic Muon Detection Rate Loss in the MINOS Particle Detector Experiment

Presenter(s)
Mobolaji Bankole, Illinois Mathematics and Science Academy

Advisor(s)
Maury Goodman, Argonne National Laboratory

Muon data collected over the duration of the MINOS detector experiment shows a small but statistically significant downtrend in the number of cosmic ray particles detected, the cause of which would be important to take into account in other particle detector experiments. A multitude of different phenomena that are known to affect cosmic rays were researched, and the most likely cause of the observed rate change was determined through analysis of the statistical relationship between its periodicity and the MINOS data. Preliminary results suggest that the sunspot cycle and the Hale Solar cycle are the most likely causes of the changes in neutrino flux, and also show that the high energy cosmic ray particles detected in the MINOS experiment and the lower energy particles that have more historical research are affected by the same phenomena. These results are serving to conclude what is causing the rate change in the MINOS detectors.

Q04
Supernovae Neutrino Interaction Modeling Through Neutrino Event Generation

Presenter(s)
Varun Iyer, Illinois Mathematics and Science Academy

Advisor(s)
Gabriel Perdue, Fermi National Accelerator Laboratory

The nature of supernovae and their properties has been an intriguing subject of research for physicists, as there have only been a few observations of these astronomical phenomena. Ninety-nine percent of the energy from core collapse is converted to neutrinos, making the study of neutrino interactions imperative to supernova research. The purpose of this study was to implement a new model for supernovae neutrino interactions into a neutrino event generator, further enhancing the observation of supernovae. The model for neutrino interactions at very-low energies (VLE) and a model for the kinematics of gamma photons released in the interaction were implemented into the neutrino event generator GENIE. Afterwards, the photon spectrum and neutrino energy spectrum of a VLE event generation were analyzed, and the number of events was varied to show the change in reliability. Results show the signature of photons necessary to distinguish a supernovae interaction from background events. For a supernovae neutrino interaction in a liquid-argon detector, four gamma photons are released with 1.3514, 2.33283, 1,65137, and 0.891398 MeV energies in that order. This investigation opens up a new method for observing and studying supernova neutrinos, supporting more reliable research in celestial object observation, as well as contributing to a universal tool for studying neutrino interactions.

Q05
Determining the Performance of Muon Ionization Detectors With Different Thresholds and Straw Diameters Based on Time and Spatial Resolution

Presenter(s)
Violet Konopka, Illinois Mathematics and Science Academy

Advisor(s)
Brendan Casey, Fermi National Accelerator Laboratory
Brendan Kiburg, Fermi National Accelerator Laboratory
Mandy Rominsky, Fermi National Accelerator Laboratory
Tammy Walton, Fermi National Accelerator Laboratory

Muons are elementary particles classified as leptons that have an average lifetime of 2.2 microseconds and is two hundred times more massive than an electron. When the muons decay, they produce an electron and two neutrinos. In the muon g-2 ring, the electrons produced by muon decay run through straws that then produce a signal. In order to find the most efficient detector straw, tests must be run to find the signal-to-noise ratio of different thresholds and straw diameters. This shows how many of those signals are actually being picked up based on these different factors. Preliminary data suggests that the most efficient straws have a threshold of less than or equal to two thousand millivolts and a radius of 0.245 centimeters or less. With larger radii or thresholds, the signal-to-noise ratios drop drastically, showing a steep decrease in efficiency. However, further testing is needed to support and refine these findings. The implication of this research is that future experiments can use these findings to produce straws that will pick up the most signals and be overall more efficient.

Q06
Effect of Surface Characteristics of Lead Glass on the Ability to Collect Light in Calorimeters

Presenter(s)
Monica Mastrud, Illinois Mathematics and Science Academy

Advisor(s)
Corrado Gatto, Fermi National Accelerator Laboratory
Anna Mazzacane, Fermi National Accelerator Laboratory

Calorimeters are used in high energy physics to measure the energy of particles produced by the collision of two beams. Dual readout calorimeters generate scintillating and Cerenkov light, providing complementary information to increase the accuracy of the measurement. Typically, only a small portion of the generated light is collected. The goal of this project was to identify characteristics of a lead glass slab that would optimize the amount of light collected. Using the platform GEANT4, simulations were run using different wrapping materials and surface roughness values. Additionally, measurements with a confocal microscope were taken of the surface of lead glass samples to determine the impact of the molds used to prepare the slabs on surface roughness. Based on simulation data, it was determined that glass slabs with a high roughness covered in teflon were optimal for the collection of Cerenkov light. Preliminary data from the microscope measurements suggests that molds sprayed with a boron nitride spray of concentrations of 120 milliliters/liter and 750 milliliters/liter create the roughest surfaces, although more measurements would need to be taken to confirm these roughness trends. This information can then be used to create an optimal glass slab to collect light in calorimeters.

Q07
Discovering the Viability of Versa Module Europa Boards as Time-to-Digital Converters Through Root

Presenter(s)
Nicholas Michuda, Illinois Mathematics and Science Academy

Advisor(s)
Jin-Yuan Wu, Fermi National Accelerator Laboratory

Measuring the speeds of subatomic particles is essential to the identification and interpretation of the data that these particles contain. These speeds are measure through time-to-digital converters (TDCs). The purpose of this investigation is to test the viability of a Versa Module Europe (VME) board as a TDC. In the first phase of the investigation, we ran a series of tests through the VME board that tested its ability to accurately measure times with an accuracy of 30 picoseconds. Time delays were put in place and the time difference between each delay was measure by the VME board. The results of these tests were then extracted and run through a program I designed in root. The results showed that the VME could accurately function as a TDC. The analysis showed that the VME was measuring the correct time delay to an accuracy of fewer than 10 picoseconds. These results confirm the fact that the VME boards can be implemented as a TDC and used in fields such as radiology and particle physics.

Q08
The Search for Standard Model Higgs Events in Associated WH Production Resulting in the b Anti-b Decay Channel With DØ Data

Presenter(s)
Dawson Patel, Illinois Mathematics and Science Academy

Advisor(s)
Ryuji Yamada, Fermi National Accelerator Laboratory

At CERN, the Higgs Boson has been found as a result of ZZ decay. This kind of decay is rare and takes very large amounts of energy to produce, while the WH decay is much more common, but more difficult to positively identify as a process that produces Higgs Bosons. In WH decay, a Higgs boson decays into two jets, mostly b and anti-b, and the W boson decays into a lepton and a neutrino. Using reprocessed data from the DØ experiments, which were run at the Tevatron, we intend to be able to identify several Higgs bosons created by WH decay. Part of the reason that finding Higgs bosons resulting from WH decay proved to be problematic was due to background interference. In order to eliminate the background, we ran a multivariable analysis. We suspect that there are several Higgs Bosons within this data, but more time is needed to confirm this. The results of this investigation will help to give more information about the Higgs bosons and potentially make them easier to study.

Q09
Discerning Cosmic Rays From Neutrino Beam Events in the NOvA Experiment

Presenter(s)
Ashrita Raghuram, Illinois Mathematics and Science Academy

Advisor(s)
Maury Goodman, Argonne National Laboratory
Louise Suter, Argonne National Laboratory

The NOvA experiment identifies neutrinos that interact in the detector using their complimentary leptons (muon, electron, or tau). Because of the non-discriminating nature of the detector, all neutrino events that interact are tracked and recorded, but some may be attributed to the detection of neutrinos from cosmic rays. This experiment relies on the beam data to be precise. Any cosmic ray neutrino contamination results in large uncertainties on all beam measurements, thus the removal of these events is essential to high quality results from this experiment. It is apparent that there is a difference between cosmic ray neutrinos and beam neutrinos, specifically in their path which is used as the basis of the simple algorithm. Containment variables track the path of the event in relation to the detector along with known time samples of the beam form an algorithm that rejects cosmic ray events. This algorithm was then run over data sets from both the near and far detector. The algorithm had a high purity, but low efficiency. This indicates that the algorithm will be successful for the near detector, because efficiency is not as important due to the high amount of events in contrast to the far detector.

Q10
Scanning Neutrino Events and Experimental Data: Monte Carlo Comparisons for Proton Scattering With Iron, Carbon, and Nickel

Presenter(s)
Alan Ren, Illinois Mathematics and Science Academy

Advisor(s)
Minerva Betancourt, Fermi National Accelerator Laboratory

At Fermilab, there is a neutrino scattering experiment, MINERvA, that produces different neutrino types interactions (for charged current: quasi-elastic, resonance and deep inelastic) and we seek to filter out the background interactions to focus on the quasi-elastic scattering. We scanned many events both from a Monte Carlo simulation and actual data produced from the MINERvA detector to identify differences in order to filter out background interactions. Through our research, we have found and identified the certain characteristics that help us identify these background interactions. We created programs in ROOT that would allow us to plot and compare the Monte Carlo simulation against proton experimental data for three different targets iron, carbon and nickel, as well as create a better fit between the two plots. The comparisons help to determine the optimal parameters to match the Monte Carlo with the experimental data. Being able to complete these two tasks allows us to better examine the quasi-elastic interactions and further our understanding of neutrinos and these elementary particles.

Q11
Free Energy Landscapes of Self-Drying Pores

Presenter(s)
Dennis Rich, Illinois Mathematics and Science Academy

Advisor(s)
Paul Jones, Northwestern University
Neelesh Patankar, Northwestern University

An ideal waterproof surface should quickly dry itself after emerging from a high-pressure underwater environment. It is possible that a surface of conical pores could immediately dry itself after being wetted under water if it has the right surface chemistry and the conical pores have appropriate cone-angles. This would happen if the free energy of the system of water and conical indentations is lower as the pore de-wets, as that would show that drying up is an energetically favorable pathway. To measure this energy, a system of water and a conical indentation in a surface made of carbon was simulated. Forces on each atom were calculated at nanoscale time steps to determine their movement. The displacements and forces thus calculated were used in a free energy calculation that depended on center of mass. The graph of the free energy shows an energy barrier where the center of mass of the water is outside the pore, indicating that the surface needs more energy to wet itself, and so favors a partially dry state. This and other results could indicate that this surface would indeed favor a dry state, and could serve as a more robust and reliable form of waterproofing.

Q12
Using Root to Visualize the Performance of Ionization Characters

Presenter(s)
Daniel Sohn, Illinois Mathematics and Science Academy

Advisor(s)
Brendan Kiburg, Fermi National Accelerator Laboratory
Tammy Walton, Fermi National Accelerator Laboratory

The muon has a gyromagnetic ratio of 2, but the actual value deviates from this by the anomalous magnetic moment because of outside factors. Previous experiments found the experimental anomalous magnetic moment to differ from the theoretical by over three standard deviations. The Muon g-2 experiment seeks to find whether this discrepancy truly exists by replicating the experiment with a higher precision. I sought to create code that would visually represent test data to show the effectiveness of the ionization detectors used for the experiment through the C++ based program Root. By looking at the time differences at which a particle passed through the different sections, we could tell whether all parts of the detector were responding correctly. Preliminary histograms, showing these time differences, created using data taken from January 2014, show that the ionization detectors are functional. The test data showed the time at which a particular particle passed through various points of the ionization detector.

Q13
Investigating Electrical Breakdown in High Voltage Feedthroughs in Liquid Argon

Presenter(s)
Alan Yang, Illinois Mathematics and Science Academy

Advisor(s)
Sarah Lockwitz, Fermi National Accelerator Laboratory
Jennifer Raaf, Fermi National Accelerator Laboratory

The behavior of plastic dielectric materials under high voltage stress in liquid argon is applicable to liquid argon time projection chamber (LArTPC) research for neutrino detection and research. High voltage feedthroughs need to be designed in order to run these particle detectors without suffering from electrical breakdown. In this investigation, five different plastics, polycarbonate, delrin acetal resin, polystyrene, polypropylene, and noryl polyphenylene oxide were tested and compared to polyethylene, the current material used. In addition, the surface breakdown observed along polyethylene-based insulators was investigated. This breakdown occurs at a much lower voltage than would be necessary to induce breakdown through its bulk. Overall, polypropylene performed strongest of the five tested. Like polyethylene, it was able to exceed 110 kV, suggesting that it is a viable candidate material for future high voltage applications. Testing indicated that surface breakdown at lower voltages occurs in the other materials as well. In addition, the cutting of grooves along the surface, hypothesized to reduce surface breakdown, was also tested. While the results suggest that grooves have a positive effect at high voltages, further testing will be necessary to better understand their effects.

Q14
Heavy Flavor Content in Events With a Z Boson and Two Jets

Presenter(s)
Timothy Zhou, Illinois Mathematics and Science Academy

Advisor(s)
Ashish Kumar, Fermi National Accelerator Laboratory

With ongoing efforts to understand the Higgs boson, there is need to account for background processes such as the production of Z bosons with heavy quark flavor jets. This project focused on measuring the ratio of cross sections for of Z+2b-jets and Z+2c-jets to Z+2 jets production. The analysis uses the data collected by the Fermilab D0 experiment from proton-antiproton collisions at center of mass energy of 2 TeV. Events with a Z boson candidate accompanied with at least two jets are selected. The data sample at this stage is dominated by light jet production. Heavy flavor jets from bottom and charm quarks are identified by making use of a dedicated algorithm which uses characteristics of the associated tracks of constituents in the jet. Application of heavy flavor tagging provides a data sample enriched with bottom and charm jets with almost negligible contribution from light jets. The fractions of 2b-jets and 2c-jets are extracted from data by performing maximum likelihood fit with the jet flavor templates obtained from simulation. The measured ratios are compared with the predictions from theoretical calculation and Monte Carlo simulation. The measurement for Z+2b-jet is reasonably consistent with expectations, but the measurement for Z+2c-jet significantly exceeds expectations. The observed disagreement is consistent with previous measurements on charm jet production which might be due to the absence of higher order terms and underestimation of gluon splitting rates.

Psychology

R01
Measuring Effective Methods of Stress Reduction for Students in Academically Rigorous Environments

Presenter(s)
Marissa Brock, Illinois Mathematics and Science Academy
Claire Lee, Illinois Mathematics and Science Academy

Advisor(s)
William Gentzler, Illinois Mathematics and Science Academy
David Lundgren, Illinois Mathematics and Science Academy
Jay Thomas, Aurora University

Stress is a growing inhibitor to the success and productivity of students in academically rigorous environments. As chronic stress can manifest into serious physical and mental illnesses, it is imperative for these students to have effective, healthy methods of stress management. This study investigates the effectiveness of two interventions, mental relaxation and exercise, at reducing student stress levels, as compared to the control; the benefits of mental relaxation and exercise are both supported by previous scientific studies. Approximately sixty junior and senior student participants from residential National Consortium of Specialized Secondary Schools (NCSSS) were evenly assigned to variable groups (exercise, mental relaxation, or control) by the school. Participants took stress-inventory surveys both prior to and immediately following their assigned 20-minute interventions. The change in quantified stress from pre- to post-intervention is being analyzed to determine which intervention is the most effective and the results will be presented. The results of this investigation should offer valuable information that can help students most effectively reduce their stress.

R02
The Effects of Social Exclusion on Emotion Intelligence and Perceived Likeability

Presenter(s)
Alice Gong, Illinois Mathematics and Science Academy
Crystal Gong, Illinois Mathematics and Science Academy

Advisor(s)
Elaine Cheung, Northwestern University
Wendi Gardner, Northwestern University

Humans are fundamentally social creatures. A lack of positive social relationships has been linked to detrimental consequences for physical and psychological health. Therefore, it is important to understand the ways in which people maintain sufficient levels of social connection. In this study, we investigated how people reconnect with their social world after exclusion. In particular, we were interested in examining how social exclusion affects emotional intelligence and perceived likeability. First, participants recalled a past experience of social exclusion or academic failure (non-social control condition). Next, participants were led to believe that they would be interacting with another participant later on in the study and were asked to make an introductory video for that participant. Participants received information that the other participant was either feeling sad due to a recent familial death (sad partner), or that the other participant was feeling fine (neutral partner). We coded participants' introductory videos for a variety of variables associated with both emotional intelligence and likability. Preliminary evidence suggests that excluded participants may display greater emotional intelligence when responding to a sad partner relative to control participants. We also found evidence suggesting that excluded individuals may be perceived as more likable, regardless of their partner's mood.

R03
Inhibitory Control as a Predictor of Drug Reward Following Amphetamine, Ethanol, and Tetrahydrocannabinol

Presenter(s)
Faithe Hill, Illinois Mathematics and Science Academy

Advisor(s)
Jessica Weafer, University of Chicago
Harriet deWit, University of Chicago

Poor inhibitory control and heightened drug response have separately been linked to drug abuse. It is not known whether the two are linked to each other. The current study looked at the relationship between inhibitory control and drug reward following amphetamine, ethanol, and tetrahydrocannabinol (THC). Inhibitory control was measured by the Stop Signal Task. Participants were classified as having either good or poor inhibitory control based on a median split of their stop signal reaction time. Subjective response was measured by the Drug Effects Questionnaire (DEQ) and Addiction Research Center Inventory (ARCI). The DEQ assessed participants' ratings on five visual analogue scales. The ARCI is a 49 item true-false questionnaire that assesses sensitivity to specific drug effects. Participants completed three placebo and three drug (amphetamine, ethanol, and THC) sessions. During the six sessions, participants completed the DEQ and ARCI at multiple time points. We compared subjective response between the groups. The poor inhibitory control group experienced heightened subjective drug response to amphetamine on the DEQ and ARCI compared to the good inhibitory control group. Yet, this was not observed after either ethanol or THC. This suggests that poor inhibitory control is a predictor of heightened drug response following amphetamine, but not ethanol or THC. These findings could help identify populations that are at risk for substance abuse and get to the root of preventing these addictions.

R04
The Variability in Heart Rates of Officers During Workdays Due to the Severity of Weather, Traffic, and the Situation

Presenter(s)
Kevin Hinterlong, Illinois Mathematics and Science Academy

Advisor(s)
James Bondi, Illinois Mathematics and Science Academy

Emergency workers frequently experience acute stress due to anticipated pressures and dangerous situations. With this information, we were interested to see the Aurora Police Department officers' responses to three stressors: weather, traffic, and the severity of the situation while driving to a call. Officers used an iPod and a wrist monitor to record pulse rate when they left for and arrived at a scene, and self-evaluated their stress levels with regard to each of the three stressors. We calculated the baselines and driving pulse rates. We used a two-way ANOVA with officers who had five or more calls where each baseline and driving pulse rate were one event nested within officers. We concluded that the officers have statistically significant differences in pulse rate. The results of the analysis indicate that there is no significant increase in pulse rate while driving to a call compared to the baseline. In addition, none of the variables under study significantly correlated with the variation, but these may be affected by the accuracy of timing. Although the results indicate no significant variability in pulse rates, emergency workers still frequently experience stress and we could further investigate with different emergency responders and more accurate instruments.

R05
The Neuropsychological Impacts of Suicidal Ideation of Urban Homeless Youth

Presenter(s)
Daniel Holley, Illinois Mathematics and Science Academy

Advisor(s)
Scott J. Hunter, University of Chicago

Urban homeless youth are frequently exposed to a variety of behavioral temptations, including substances of abuse, which when paired with family challenges and executive dysfunction may result in higher vulnerability to increased suicidal ideation and risk. The aim of this project is to address the relationships that may exist between developing executive functioning, suicidal risk, and the following factors: risky sexual behavior, tobacco, marijuana, alcohol, and other drug use in urban homeless youth. One-hundred forty-eight homeless young adults of ages 18-22 years were interviewed at homeless shelters in Chicago and Los Angeles. Rates of risky behavior engagement, specifically involving drug use and sexual activity, were assessed using a modified version of the Centers for Disease Control's Youth Risk Behavior Survey. Executive function was measured using a self-report form of the Behavior Rating Inventory of Executive Function. It was found that homeless urban youth who exhibit current suicidal ideation were more likely to use cigarettes, cigars, marijuana, ecstasy, alcohol, and prescription medications without a prescription. Notably, these same youth were identified as showing greater executive dysfunction. These results suggest that suicidal homeless urban youth are more likely to abuse substances and show less inhibition, which heightens their risk for self-harm.

R06
How Self-Perception of Work Ethic Differs From Observer Perception in IMSA Students

Presenter(s)
Ashley Kerley, Illinois Mathematics and Science Academy
Livia Way, Illinois Mathematics and Science Academy

Advisor(s)
David Evenson, Illinois Mathematics and Science Academy

Positive work ethic is essential to success at the Illinois Mathematics and Science Academy (IMSA). Understanding how work ethic is perceived is equally, if not more, important. This investigation aimed to study the self-perception and observer perception in IMSA students using a combination of surveys and personal interviews. The objectives of this investigation is to increase understanding of the differences in self-perception and observer perception of work ethic at IMSA and hypothesize how a student's self-perception of work ethic relates to other aspects of the self. In order to do this, a class of IMSA sophomores completed a personal survey pertaining to their self-perception and a follow-up interview about their perception of their classmates. These results will be analyzed using a Chi-square goodness-of-fit test in order to form a conclusion. Our preliminary research suggests that adolescents have a tendency to have a higher self-perception than observer perception, therefore we believe this will be reflected in our results, however they are still pending. Our results and conclusions will be presented at IMSAloquium.

R07
The Effects of Depression on Memory in Dementia Patients

Presenter(s)
Kaitlyn Schmieder, Illinois Mathematics and Science Academy

Advisor(s)
Maureen Lacy, University of Chicago
Todd Nader, University of Chicago

Dementia is a progressive deterioration of memory and other cognitive abilities that inhibits a person's ability to participate in normal activities. Depression is a mood disorder that also impacts daily living. In my retrospective study the impact of depression on memory in a group of patients presenting for dementia exam was examined. The participants included two-hundred eighty-three adults with a mean age of 78.8 (standard deviation = 6.7), 13.7 years of education (sd = 3.5), and average premorbid intellect of 99.3 (sd = 16.7). Twenty-three percent of older adults presenting for dementia assessment additionally reported depression. Means, frequencies, and correlations were determined between standard measures of depression (Geriatric Depressive Scale), and a dementia screening tool (Mini Mental State Examination) and verbal memory measures (Hopkins Verbal Learning Test and Story Memory from the Repeatable Battery for the Assessment of Neuropsychological Status). It was concluded that depression impacts memory performance in older adults. Depression negatively correlates with verbal learning, delayed recall, and premorbid intelligence estimate, but not with recognition memory performance or immediate recall. This may be due to the fact that depression causes difficulties in concentration and motivation, which may hinder learning and the formation of long-term memories.

R08
The Effects of State and Trait Anxiety on Subjective Effects of Alcohol Use

Presenter(s)
Aniruddha Shekara, Illinois Mathematics and Science Academy

Advisor(s)
Melissa Miller, University of Chicago
Harriet de Wit, University of Chicago

Negative moods such as anxiety have been shown to increase risk for alcohol abuse; however this relationship is not completely understood. The current study examined anxiety, both as a chronic trait and temporary mood state, and sensitivity to the subjective effects of alcohol in two studies. In both studies, participants received an alcohol dose (0.65 grams/kilogram) or placebo, and reported how they felt while intoxicated. Study 1 (n=141) measured trait anxiety in the sample using the State Trait Anxiety Scale. Alcohol-induced sedation and stimulation were measured by the Biphasic Alcohol Effects Scale (BAES). The findings showed that participants with greater anxiety reported less alcohol-induced sedation on the BAES. In study 2 (n=29), anxious mood at the time of testing was measured by the Profile of Mood States, and subjective alcohol responses with the Drug Effects Questionnaire. Here, participants with greater state anxiety felt less intoxicated than those who were less anxious. Together, these results suggest that generally anxious people may be at an increased risk for alcohol abuse because they feel less sedation from the drug, and might drink more to reduce their anxiety. Additionally, people who feel anxious at the time of consumption may also be at risk due to their decreased feeling of intoxication. These findings increase our understanding of how mood states and traits influence the subjective responses to alcohol.

R09
Observing the Extent of the Implicit Associations Within the IMSA Community

Presenter(s)
Kyle Thomas, Illinois Mathematics and Science Academy

Advisor(s)
Adrienne Coleman, Illinois Mathematics and Science Academy

Implicit associations are essential to understanding the origins of stereotypes and social profiling based on race, gender, and sexual orientation. In an effort to understand the extent of specific associations within the IMSA community, this investigation involved testing students on their preferences for different groups of people. The implicit association tests (IAT) were administered utilizing the Harvard Project Implicit Association instrument, testing the majority of IMSA students (n=580). This investigation included three tests, all of which are emphasized in the IMSA Diversity Plan: the Skin-Tone, Gender-Science, and Sexuality IAT. The Skin-Tone IAT showed a slight preference for light-skinned individuals. The Gender-Science IAT displayed a campus-wide slight inclination for males with science and females with the liberal arts. The Sexuality IAT illustrated a slight preference for heterosexual persons within the IMSA community. While there was revealed to be slight preferences for the majority group in the three situations, the results by race, class, gender, and hall differ in some cases. This data suggests that IMSA can still provide educational opportunities to remove biases from the IMSA community. Future studies should include other IATs about religion, ability, and age. All of which are areas included in the IMSA Diversity Plan.

Social Science

S01
Factors That Mediate HIV Sexual Risk Behaviors in Academically Talented African American Youth

Presenter(s)
Amber Acquaye, Illinois Mathematics and Science Academy

Advisor(s)
Camesha Jones, University of Chicago
Dexter Voisin, University of Chicago

Estimates from the Center for Disease Control state that African American youth represent more than half (57 percent) of all new HIV infections among young people aged 13 to 24. This investigation proposes to examine how community factors, including parental support, self-esteem, and mental health, mediate sexual risk behaviors that increase ones' risk for contracting HIV in African American, academically talented youth. A survey was conducted at the Illinois Mathematics and Science Academy and the sample population was the African American student population. The study participants were surveyed in three staff-supervised sessions. A parent survey was sent to parents of the student participant through email and was coupled with the child's for data analysis. The goal was to see if there is a correlation between community factors and HIV-related sexual risk behaviors among gifted and talented African American youth. Preliminary results showed that there is a negative correlation between parent's involvement in educating their child about protection from STD's and condom use. The higher the parent's involvement in sex education about STD's the lower the chance their child will not use condoms when they are a sexually active.

S02
Possible Racial and Ethnic Segregation on Social Media With Multi-Color Populations

Presenter(s)
Susriya Gangireddy, Illinois Mathematics and Science Academy

Advisor(s)
Narendra Jaggi, Illinois Wesleyan University

An examination of urban areas in the United States shows that racial neighborhood segregation still exists in our society. Our focus is on racial/ethnic segregation in virtual communities, if any. Researching online racial/ethnic segregation is more revealing than researching neighborhood segregation because of fewer outside factors like economic status and government intervention, meaning that people are more willing to freely interact with others without restricting themselves. If this racial/ethnic segregation does exist, we want to study the extent, the nature, the possible metrics for characterizing it, and the possible mechanisms of racial/ethnic segregation in social media. Our study is particularly using Facebook because of its prevalence in social media. We want to explore the friends of individuals to see if any racial/ethnic patterns exist showing their preference to be friends with some kinds of people compared to others. Our results show that there is no significant difference in the ethnic percentages of the friends of individual from a certain ethnicity. However, one must consider that this was a small and irregular sample as most of the students who took the survey went to a diverse, residential high school.

S03
Does Student Dress Affect Teacher Grading?

Presenter(s)
Cameron Hudgins, Illinois Mathematics and Science Academy

Advisor(s)
Deborah Scarano, Illinois Mathematics and Science Academy

In today's schools student attire ranges from very informal, wearing sleep wear to school, to professional, wearing suits and business dress on a regular basis. The way a student dresses may influence teachers to form conscious and subconscious opinions about some students. In this investigation a combination of an Implicit Association Test (IAT) and a student survey were used to determine if there is a relationship between the formality with which a student dresses and the grades he or she earns. The IAT, which was completed by teachers, was used to determine if teachers have subconscious biases which cause them to assume that students who dress more formally earn better grades. Students also completed a survey to determine if this there was a correlation between the formality of their dress and the grades that they earned independent of teacher bias. Analysis of the student surveys using a Spearman Rank Correlation found a correlation rank of 0.18 between the formality with which students dress and the grades they receive, implying a very weak correlation. However, the IAT had an average expression d value of 0.85, this implies teachers associate formal dress with better grades. This may indicate that although teachers display a bias associating formality of dress with better grades their grading practices do not reflect this bias.

S04
Cinematocracy: Social and Political Anxieties About Russia in Film

Presenter(s)
Nicholas Kiene, Illinois Mathematics and Science Academy
Vivian Liu, Illinois Mathematics and Science Academy

Advisor(s)
Malynne Sternstein, University of Chicago

Prominent themes in horror films have long included revenants of many species, including vampires, werewolves, and zombies. In particular, horror films have seen the prominence of the Russian monstrosities. Some prime examples include *Taken 3*, *Red Dawn*, and *Chernobyl Diaries*. Film has long been a medium of communication; this investigation seeks to uncover why the Russian revenant is so popular and how the formal elements of film contribute to viewers' perceptions of Russian culture and understandings of social and political anxieties. Theories on the psychology of horror, film analysis, and quantitative analysis were used to explore the ways the West continues to hold social anxieties and misconceptions about Eastern Europe. In addition, themes in Russian and Soviet films like *Cargo 200* and *Repentance* demonstrate Russia's own social and political anxieties. It is likely that the nature of monstrosity lies in the culture of origin and is determined by that culture's specific fears and anxieties.

S05
The Understanding of African American Females' Journeys in Pursuit of a Career in the STEM Fields

Presenter(s)
Trennedy Kleczewski, Illinois Mathematics and Science Academy

Advisor(s)
Adrienne Coleman, Illinois Mathematics and Science Academy
Anita White, Illinois Mathematics and Science Academy

The span of African American females working in the science, technology, engineering, or mathematics (STEM) fields is less than any other major ethnic and/or gender group. Therefore, the goal of the investigation is to understand whom and what influenced African American women's interests to pursue a career in STEM, in which they are underrepresented. I designed and established an original survey to address African American women's views on racism, isolation, and pressure in the workplace due to their race, background, appearance, and how their pasts have influenced their cultural differences among their co-workers. African American women that currently work in the STEM fields and are Illinois Mathematics and Science Academy alumni were surveyed and asked to share their personal experiences that led them to their current career choice. Their responses were analyzed by individual question in order to discover overarching themes, patterns, and trends. Preliminary results suggest that the biggest influence on their career choice was associated with a specific event. In addition, many began to desire to study topics in STEM during middle school. It was also noted that many respondents stated that racism is still prominent in professional working environments.

Space Science

T01
Simulating the Movement and Fragmentation of a Meteor Descending Through the Atmosphere

Presenter(s)
William Drennan, Illinois Mathematics and Science Academy

Advisor(s)
Mark Hammergren, Adler Planetarium
Lou Nigra, Adler Planetarium
Ken Walczak, Adler Planetarium

We designed a program to track and record the dynamics and structural modification of meteors during atmospheric entry as they are subjected to the effects of fragmentation and ablation. Previous studies have looked at how meteor luminosity evolves during flight as a result of fragmentation and burn up in the atmosphere, details of which were modeled by relating meteor motion and behavior to material composition and initial kinematic states. Our model used a fourth order Runge Kutta numerical integrator written in Python to track meteor behavior by applying equations for the rates of change in the position, velocity, and mass of a descending meteor. Using Numpy and Matplotlib functions, we displayed and measured the distribution of meteor fragments on the ground and looked at the effects of altering assumed physical characteristics. By running this model using the characteristics of carefully documented meteors, we found that increasing the assumed compression strength of a meteor results in fewer fragments, a greater maximum fragment mass, and a longer distribution of the fragments. The fragment distributions simulated by our model may allow us to estimate the undocumented physical characteristics and initial kinematic states of meteors.

T02
Mapping Red Clump Stars in North and South Galactic Caps

Presenter(s)
Arianna Osar, Illinois Mathematics and Science Academy

Advisor(s)
James Annis, Fermi National Accelerator Laboratory

Red clump stars (RCs) serve as accurate distance indicators due to their small dispersion in absolute magnitude, and thus small distance error. I constructed color search boxes, which varied greatly between different metallicities, and created distance slices from apparent magnitudes. The colors and magnitudes used are from Sloan Digital Sky Survey (SDSS) and Dark Energy Survey system response curves (the filters for the telescope). Using SDSS data, color density maps were created for two metallicities: [Fe/H] = -0.6 and [Fe/H] = 0. The Large Magellanic Cloud is known to have RCs in them, and has a metallicity centered around -0.6. Our maps show most high densities lie near the galactic plane. We speculated densities to be contamination from K dwarves, which have the same color range as RCs, but are more abundant. Any other peaks were found to be areas with high dust density, which changes the color (dereddening correction is inaccurate in these particular areas). Thus we do not see any significant red clump star structure with either metallicity using SDSS data. We expect that progress can be made with more accurate background subtraction methods.

T03
Designing Life Support Systems on a Space Settlement

Presenter(s)
Erich Remiker, Illinois Mathematics and Science Academy
Vinay Sama, Illinois Mathematics and Science Academy

Advisor(s)
Eric Hawker, Illinois Mathematics and Science Academy

Life support systems on a space settlement are of the utmost importance to the settlement's overall design. Water is very useful on a space settlement, as it is required for agriculture, and can be stored and used as radiation shielding. A search of the current literature and research on the topic was conducted. Water management has several steps: capture, purification/temperature control, and redistribution. For capture, the goal is that no water leaves the vicinity. On a closed space settlement, this step can be completed without any sort of additional technology or innovation. The purification step needs to use the least energy possible while having the highest efficiency. High efficiency reverse osmosis is a water purification system with a high recovery rate and a relatively low energy use, and is therefore perfect for this project. Temperature control requires stringent monitoring and the usage of energy to keep the water at an acceptable temperature. Redistribution is an easy topic to resolve, as it is more or less the construction of a pipe infrastructure. To manage waste on the space settlement, solid waste will be reused as a biofuel.

T04
Using a Galactic Model to Search for Red Clump Stars in the Sagittarius Stream

Presenter(s)
Anabel Rivera, Illinois Mathematics and Science Academy

Advisor(s)
James Annis, Fermi National Accelerator Laboratory
Tom Diehl, Fermi National Accelerator Laboratory

There are great streams of stars orbiting the Milky Way, debris from tidally disrupted dwarf galaxies. Red clump stars (RCs) have a low dispersion of absolute magnitude and color, and are good indicators of distance. We seek to use RCs to find streams and measure their distances. However, it is difficult to distinguish RCs from the foreground of galactic stars. RCs have been found in streams; we know their surface density is ~3 stars/degree^2, with a wide variation. The previous IMSA researcher Osar found foregrounds to be high. We studied the galactic model, Galaxia, to see if it can predict foregrounds. It has eleven components, each of which has a different stellar population. We demonstrated that Galaxia's models work well in the color ranges of interest. Osar broke RCs into eight distance bins between 5 and 80 kiloparsecs (kpc). We generated Galaxia models for these bins and turned them into maps. We have subtracted these maps from the Sloan Digital Sky Survey. The foreground-subtracted maps are still being produced. The first map, at 20 kpc, suggests the presence the Sagittarius Stream. We need to learn how to filter the maps to bring out the structures of interest since the foreground subtraction leaves RCs with a spatial density of 8 stars/degree^2, which is within the range of densities of stellar streams. We will make maps for the North and South Galactic caps, and in the future will use these techniques on the Dark Energy Survey data.

2013-2014 Student Recognition

The below accomplishments are a summary from the 2013- 2014 academic year.

Prachi Aggarwal: Examining Asthma Prevalence and Improving Medication Access in Chicago Public Schools
Advisors: Ashley Dyer, Ruchi Gupta, Chris Warren, and Emily Zadikoff, Northwestern University
Presentation at the American Junior Academy of Science at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Charlene Angeles: The Impact of Narcolepsy on Self-Image and Quality of Life in Young Adults
Advisor: Mary Kapella, University of Illinois at Chicago
Co-presenter at 7th Annual Meeting of the Associated Professional Sleep Societies, June 1-5, 2013

Ashok Arjunakani: The Effect of Various Concentrations of Lipids on Phase Changes in the Cell Membrane
Advisor: Adam Hammond, University of Chicago
Presentation at the 9th International Student Science Fair, July 11-15, 2013, in Cornwall, England

Ashok Arjunakani: The Effect of Nitric Oxide on Cellular Adhesion in Various Cancer Cell Lines
Advisors: Madeeha Agil, Kim Elseth, and James Radosevich, University of Illinois at Chicago
Illinois Junior Academy of Science Region V Project Exposition Finalist; IJAS State Competition: gold award; Intel ISEF Finalist; Coauthor of paper published in Tumor Biology, December, 2014, "A549 Cells Adapted to High Nitric Oxide Show Reduced Surface CEACAM Expression and Altered Adhesion and Migration Properties" (Madeeha Aqil, Kim M. Elseth, ***Ashok Arjunakani, Philip Nebres, Courtney P. Amegashie****, and James A. Radosevich)*

Wendy Bindeman*: Ccl22 to Activate Treg Migration and Suppress Depigmentation in Mice
Advisor: Caroline Le Poole, Loyola University
Coauthor of paper published in the J Invest Dermatol. 2015, (Eby JM, Kang HK, Tully ST, ***Bindeman WE****, Peiffer DS, Chatterjee S, Mehrotra S, Caroline Le Poole)*

Ryan Chiu: Uncovering the Role of PTEN in Mediating the Decrease of Pancreatic Inflammation Signals by Omega-3 Fatty Acids
Advisor: Paul Grippo, Northwestern University
Presentation at the 9th International Student Science Fair, July 11-15, 2013, in Cornwall, England

Lael Costa: Understanding the Dimensions of String Theory: The Betti Numbers of Calabi-Yau Manifolds
Advisor: Nir Avani, Northwestern University
Poster presented at STEM Summit 2014: Engage Your Brain, February 28, 2014 at Hinsdale Central High School

Lael Costa: Benefits of High School Student Research Opportunities
Student panelist at STEM Summit 2014: Engage Your Brain, February 28, 2014 at Hinsdale Central High School

Matthew Deng: Density Functional Theory Investigation of Silicene and Metal Adatoms
Advisors: Ron Hurlbut and Glenn "Max" McGee, Illinois Mathematics and Science Academy
*Presented and published in the Singapore International Science Challenge Proceeding, 2013, July 1-5, pages 80-94 (**Kent Gang, Siva Gangavarapu**, **Matthew Deng**, Max McGee, Ron Hurlbut, Michael Lee Dao Kang, Sean Ng Peng Nam, Harman Johll, and Tok Eng Soon; Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois*

Jennifer Du: Molecular Cloning of Cellulolytic Enzymes From *Acidothermus cellulolyticus*
Advisor: Aldwin Anterola, Southern Illinois University at Carbondale
Illinois Junior Academy of Science Region V Project Exposition Finalist

Grace Duan: Identification of Active Brain Regions During Sleep
Advisors: Jennie Yufen Chen and Todd Parrish, Northwestern University
Illinois Junior Academy of Science Region V Project Exposition Finalist; IJAS State Competition: silver award; Intel ISEF Finalist

Cassandra Erwin: Team Titan Shielding Systems
Advisor: Eric Hawker, Illinois Mathematics and Science Academy
NASA Exploration Design Challenge Finalist

Ryan Franks: Team Titan Shielding Systems
Advisor: Eric Hawker, Illinois Mathematics and Science Academy
NASA Exploration Design Challenge Finalist

Kent Gang: Density Functional Theory Investigation of Silicene and Metal Adatoms
Advisors: Ron Hurlbut and Glenn "Max" McGee, Illinois Mathematics and Science Academy
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Siva Gangavarapu: Density Functional Theory Investigation of Silicene and Metal Adatoms
Advisors: Ron Hurlbut and Glenn "Max" McGee, Illinois Mathematics and Science Academy
*Presented and published in the Singapore International Science Challenge Proceeding, 2013, July 1-5, pages 80-94 (**Kent Gang, Siva Gangavarapu, Matthew Deng,** Max McGee, Ron Hurlbut, Michael Lee Dao Kang, Sean Ng Peng Nam, Harman Johll, and Tok Eng Soon; Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois*

Al-Jalil Gault: The Experience of Homelessness and Stress and its Effect on Memory Functioning in Homeless Youth
Advisor: Scott J. Hunter, University of Chicago
Poster presented at STEM Summit 2014: Engage Your Brain, February 28, 2014 at Hinsdale Central High School

Anna Gupta: Building an Efficient Egg-Based Antibacterial Water Filter
Advisor: Mark Carlson, Illinois Mathematics and Science Academy
Poster presentation at the U.S. Stockholm Junior Water Prize National Competition, June 14-16, 2013, Portland, Oregon; Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois; Poster presentation and award at the Illinois Water Environment Association WATERCON banquet, March 17, 2014, Springfield, Illinois; Presentation at the Illinois section of the American Water Works Association conference March 19, 2014 Springfield, Illinois

Claire Hensley: Team Titan Shielding Systems
Advisor: Eric Hawker, Illinois Mathematics and Science Academy
NASA Exploration Design Challenge finalist

Michael Hrcek: Team Titan Shielding Systems
Advisor: Eric Hawker, Illinois Mathematics and Science Academy
NASA Exploration Design Challenge finalist

Shreya Jain: Achieving Hippocampus Activation Through fMRI Tests
Advisor: Todd Parrish; Northwestern University
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Omkar Kelkar: An Analysis of Regulated and Disrupted E4BP4 Circadian Waveforms in Siberian Hamsters
Advisor: Brian Prendergast, University of Chicago
Presentation at the American Junior Academy of Science at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Omair Khan: Burns Alter the Intestinal Microbiota and Increases Inflammation and Sepsis
Advisors: Mashkoor Choudhry and Zackary Earley, Loyola University
Illinois Junior Academy of Science Region V Project Exposition Finalist: Special award from the Society for In Vitro Biology; IJAS State Competition: gold award, HSLE special award Cellular and Molecular Biology

Srisha Kotlo: Analysis of Critcal PKC-delta Sites on Sarcomeric Protein Phosphorylation and Function
Advisor: Marcus Henze, University of Illinois at Chicago
Siemens Competition Regional Semi-Finalist; Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois; Illinois Junior Academy of Science Region V Project Exposition Finalist

Sanjay Kottapali: Evaluating Molecular Function
Advisors: Debabrata Chakravarti and J. Brandon Parker, Northwestern University
Illinois Junior Academy of Science Region V Project Exposition Finalist; IJAS State Competition: gold award, Best in Category, Cellular and Molecular Biology

Anna Kryczka: Achieving Hippocampus Activation Through fMRI Tests
Advisor: Todd Parrish, Northwestern University
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Maria Kuznetsov: Effects of Gestational Hormones on Free Fatty Acid Receptor 2 Expression During Pregnancy
Advisor: Brian Layden, Northwestern University
Presentation at Japan Super Science Fair (JSSF) Kyoto, Japan, November 6-13, 2013

Lakhena Leang: Creating an Isogenic Inducible Model for ALS-related FUS R521G Aggregation in Neuro2A cells
Advisor: Richard Morimoto, Northwestern University
Siemens Competition Regional Semi-Finalist

Mack Lee: Analysis of Rate Outage with Fractional Frequency Reuse and Interference Cancellation
Advisors: Randall Berry and Vijay Subramanian, Northwestern University
*Co-presenter at the IEEE Ninth Workshop on Spatial Stochastic Models for Wireless Networks, May 13, 2013, Tsukuba Science City, Japan (Lan Xing, **Mack Lee**, Rajeev Agrawal, Randall Berry, Vijay Subramanian)*

Judy Li: Analysis of Glial Activation in R6/2-YFP Mice: A Novel Mouse Model for the Analysis of Axonal Degeneration in Huntington's Disease
Advisors: Rudolfo Gatto and Gerardo Morfini, University of Illinois at Chicago
Presentation at Japan Super Science Fair (JSSF) Kyoto, Japan, November 6-13, 2013

David Lisk: Building an Efficient Egg-Based Antibacterial Water Filter
Advisor: Mark Carlson; Illinois Mathematics and Science Academy
Poster presentation at the U.S. Stockholm Junior Water Prize National Competition, June 14-16, 2013, Portland, Oregon; Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois; Poster presentation and award at the Illinois Water Environment Association WATERCON banquet, March 17, 2014, Springfield, Illinois; Presentation at the Illinois section of the American Water Works Association conference March 19, 2014, Springfield, Illinois

Vivian Liu: Structural Studies of Llama Antibodies in Complex with HIV-1 gp120
Advisor: Lei Chen, National Institutes of Health
3rd place, Cellular and Molecular Biology, Sigma Xi Student Research Showcase

Sameeksha Malhotra: Identification of Active Brain Regions During Sleep
Advisors: Jennie Yufen Chen and Todd Parrish; Northwestern University
Illinois Junior Academy of Science Region V Project Exposition Finalist; IJAS State Competition: silver award; Intel ISEF finalist

Alec Mangan: Team Titan Shielding Systems
Advisor: Eric Hawker, Illinois Mathematics and Science Academy
NASA Exploration Design Challenge finalist

Alonzo Marsh: Team Titan Shielding Systems
Advisor: Eric Hawker, Illinois Mathematics and Science Academy
NASA Exploration Design Challenge finalist

Sruthi Mothkur: Non-Linear Relationship Between T-Tubule Remodeling and Sr Calcium Release in Failing Rat Ventricle
Advisor: J. Andrew Wasserstrom, Northwestern University
*Co-author of abstract published in Biophysical Journal, 2014, Volume 106, Issue 2, and co-presenter at the 58th annual meeting of the Biophysical Society Feb 15-19, 2014, San Francisco, CA (Jasleen Singh, Nikhil Bassi, **Shannon Tai*, Shruthi Mothkur**, William Marszalec, Neha Singh, Gary L. Aistrup, J. Andrew Wasserstrom)*

Philip Nebres: The Effect of Varying Concentration Levels of Lipids on Phase Separation
Advisor: Adam Hammond; University of Chicago
Presentation at the 9th International Student Science Fair, July 11-15, 2013, in Cornwall, England; Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Philip Nebres: The Effect of Nitric Oxide on Cellular Adhesion in Various Cancer Cell Lines
Advisors: Madeeha Agil, Kim Elseth, and James Radosevich, University of Illinois at Chicago
*Illinois Junior Academy of Science Region V Project Exposition Finalist: IJAS State Competition: gold award, Lyell J. Thomas Scholarship; Intel ISEF Finalist; Coauthor of paper published in Tumor Biology, December, 2014, "A549 Cells Adapted to High Nitric Oxide Show Reduced Surface CEACAM Expression and Altered Adhesion and Migration Properties" (Madeeha Aqil, Kim M. Elseth, **Ashok Arjunakani, Philip Nebres, Courtney P. Amegashie**, and James A. Radosevich)*

Michelle Park: The pH of Drinks and Their Effect on Teeth
Advisor: Don Dosch, Illinois Mathematics and Science Academy
Poster presented at STEM Summit 2014: Engage Your Brain, February 28, 2014 at Hinsdale Central High School

Jenson Phung: Examining Asthma Prevalence and Improving Medication Access in Chicago Public Schools
Advisors: Ashley Dyer, Ruchi Gupta, Chris Warren, and Emily Zadikoff, Northwestern University
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Cristal Quinones: The pH of Drinks and Their Effect on Teeth
Advisor: Don Dosch, Illinois Mathematics and Science Academy
Poster presented at STEM Summit 2014: Engage Your Brain, February 28, 2014, at Hinsdale Central High School

Aishwarya Raj: Analysis of Metabolic Pathways and the Relationship to KDM5A and the Retinoblastoma 1 Gene
Advisor: Elizaveta Benevolenskaya, University of Illinois at Chicago
Sigma Xi Student Research Showcase

Vignesh Ravi: Visualization of CSMN in the Disease Models of ALS Using Novel UCHL1-eGFP Reporter Mice Reveals Details of Cellular Vulnerability
Advisor: H. Pembe Ozdinler, Northwestern University
Co-author of poster presented at the 25th International Symposium on ALS/MND, December 5 -7, 2014, in Brussels, Belgium *(M. Gautam, G. Sekerkova, **V. Ravi**, M. Yasvoina, J. Jara, M. Martina, H. Ozdinler)*

Xueyang Ren: Creating an Isogenic Inducible Model for ALS-Related FUS R521G Aggregation in Neuro2A cells
Advisor: Richard Morimoto, Northwestern University
Siemens Competition Regional Semi-Finalist

Daniel Rosenthal: Metal-Assisted Etching of Silicon Molds for Electroforming
Advisors: Ralu Divan and Leonidas Ocola, Argonne National Laboratory
Co-author of paper in Journal of Vacuum Science and Technology B 31(6), 2013; http://dx.doi.org/10.1116/1.4821651 *(Ralu Divan, **Dan Rosenthal**, Karim Ogando, Leonidas E. Ocola, Daniel Rosenmann and Nicolaie Moldovan)*

Daniel Rosenthal: Fabrication of Semiconductor Nanostructures by Metal-Assisted Chemical Etching
Advisors: Ralu Divan and Leonidas Ocola, Argonne National Laboratory
Poster presented at STEM Summit 2014: Engage Your Brain, February 28, 2014 at Hinsdale Central High School; Participated in YouTube video "A Look Inside Argonne's Center for Nanoscale Materials" Published on Jan 29, 2014, https://www.youtube.com/watch?v=E6Krh7tozGY

Shreya Santhanam: Examining Asthma Prevalence and Improving Medication Access in Chicago Public Schools
Advisors; Ashley Dyer, Ruchi Gupta, Chris Warren, and Emily Zadikoff, Northwestern University
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Sreyesh Satpathy: Magnetic Resonance Probe Optimization for Early Detection of Alzheimer's Disease
Advisors: William Klein and Kirsten Viola, Northwestern University
*Siemens Competition Regional Semi-Finalist; Illinois Junior Academy of Science Paper Exposition; Illinois Junior Academy of Science Region V Project Exposition Finalist; IJAS State Competition: gold award; coauthor of paper published in Nature Nanotechnology, Vol. 10, January 2015, "Towards non-invasive diagnostic imaging of early-stage Alzheimer's disease" (Kirsten L. Viola, James Sbarboro, Ruchi Sureka, Mrinmoy De, Maíra A. Bicca Jane Wang, Shaleen Vasavada, **Sreyesh Satpathy**, **Summer Wu***, Hrushikesh Joshi, Pauline T. Velasco, Keith MacRenaris, E. Alex Waters, Chang Lu, Joseph Phan, Pascale Lacor, Pottumarthi Prasad, Vinayak P. Dravid, and William L. Klein)*

Janani Sivakumar: Identification of Gravitationally Lensed Quasars: A Morphological Approach
Advisor: Sivakumar Muthuswamy, Motorola Solutions
Siemens Competition Regional Semi-Finalist

Simona Stancov: The Role of Gut Microbes in Regulating Dietary Fat-Mediated Alterations of Nuclear Hormone Receptor Expression and Metabolism
Advisor: Kristina Martinez, University of Chicago
Presentation at Japan Super Science Fair (JSSF) Kyoto, Japan, November 6-13, 2013; 39th Annual Chicago Region Junior Science and Humanities Symposium Finalist

Ranjani Sundar: Phthalates and Phthalate Alternatives: Effects on Proliferative and Estrogenic Target Genes in Ishikawa Cells
Advisors: Serdar Bulun and Ping Yin, Northwestern University
*Co-author of paper to be published in Young Scientist Journal, Vol. 4, May 2014 (**Ranjani Sundar**, Ping Yin, Serdar E. Bulun); 39th Annual Chicago Region Junior Science and Humanities Symposium Alternate; Illinois Junior Academy of Science Region V Project Exposition Finalist; IJAS State Competition: gold award, Best in Category, Biochemistry; Intel ISEF finalist; Sigma Xi: Student Research Showcase*

Poornima Sundaravelu: Allelic Variation in Catechol-o-Methyltransferase and Interpersonal Stressors on Adolescent Well-Being
Advisor: Eva Telzer; University of Illinois at Urbana- Champaign
Poster presented at STEM Summit 2014: Engage Your Brain, February 28, 2014 at Hinsdale Central High School

Sai Talluru: The Experience of *GATA6* Mutations of All Subjects in the Monogenic Diabetes Registry
Advisors: Graeme Bell, David Carmody, and Siri Atma Greeley, University of Chicago
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Rashmi Thimmapuram: Novel Method to Find the Language Region Using Electrocorticography During Natural Conversion
Advisor: Vernon Leo Towle, University of Chicago
39th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science Region V Project Exposition Finalist: Special Award from the Navy; Poster presentation at the 13th Annual High School Research Symposium, April 25, 2014, Normal, IL

Lynette To: Developing an Efficient Immunization Method to Elicit CD8+ T cells in Response to Qa-1-restricted Mtb-Specific Peptides
Advisors: Yao Bian and Chung-Ru Wang; Northwestern University
Presentation at Japan Super Science Fair (JSSF) Kyoto, Japan, November 6-13, 2013

Shruti R. Topudurti: The Effect of Small Molecule 390 on CXCR4 Receptors
Advisors: Richard J. Miller and Andrew Shum, Northwestern University
*Co-author of paper to be published in Young Scientist Journal, Vol. 4, May 2014 (**Selam B. Zenebe-Gete**, **Shruti R. Topudurti**, Andrew Shum, Richard J. Miller)*

Lia Vallina: An OPERA-3d Model of Muon Injection in the Muon g-2 Storage Ring
Advisor: Brendan Kiburg, Fermi National Accelerator Laboratory
Presentation at the American Physical Society Conference, Savannah, Georgia, April 4-7, 2014

Stephanie Wang: A Novel Design Verifying Field Programmable Gate Arrays' Radiation-Tolerance
Advisor: Jinyuan Wu, Fermi National Accelerator Laboratory
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

Stephanie Wang: The CAKE Clocking and the Trapezoidal Clocking Schemes: Principles and Demo Tests
Advisor: Jinyuan Wu, Fermi National Accelerator Laboratory
*Co-presenter at the IEEE Nuclear Science Symposium and Medical Imaging Conference and Workshop on Room-Temperature Semiconductor X-ray and Gamma Ray Detectors, 2013 Seoul Korea Oct 27-Nov 2, 2013 (J. Wu, **S. Wang,** K. Zhang)*

Selam B. Zenebe-Gete: The Effect of Small Molecule 390 on CXCR4 Receptors
Advisors: Richard J. Miller and Andrew Shum; Northwestern University
*Co-author of paper to be published in Young Scientist Journal, Vol. 4, May 2014 (**Selam B. Zenebe-Gete**, **Shruti R. Topudurti**, Andrew Shum, Richard J. Miller)*

Luke Zhan: Regulation of Type II NKT Cell Cytokine Production by SLAM-Associated Protein
Advisors: Chyung-Ru Wang and Xiufang Weng, Northwestern University
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 12-16, 2014, in Chicago, Illinois

*Alumna, class of 2012.

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* Lydia Stone is attending the Junior Sciences and Humanities Symposium National Conference and will present at an alternate time.