



IMSAloquium

STUDENT INVESTIGATION SHOWCASE



Years of SIR

May 2, 2013

www.imsa.edu

IMSAloquium

STUDENT INVESTIGATION SHOWCASE

April 2013

Dear IMSA Friends:

This year, we are proudly celebrating the twenty-fifth anniversary of IMSA's Student Inquiry and Research (SIR) Program. Our first IMSAloquium, then called Presentation Day, was held in 1989 with only ten presentations; this year we are nearing two hundred. In 1989, there was no Internet, the Human Genome Project (HGP) had just been launched, and Dr. Leon Lederman, one of IMSA's founding fathers and former director of Fermilab, won the Nobel Prize for his work on neutrinos. In 2013, students now use the Internet to conduct SIR projects with student colleagues and faculty advisors in China and Singapore; access HGP results to pursue advanced studies in genetics; and work side by side with scientists at Fermilab actively conducting research on neutrinos, quarks, and other mysteries of particle physics. What a difference twenty-five years makes! An important common thread connecting these past twenty-five years is the fact that these authentic research experiences have developed habits of mind in critical thinking, thorough analysis, and bold exploration that serve both students and humanity well. In the words of our mission statement, SIR clearly "ignites and nurtures creative, ethical, scientific minds that advance the human condition."

In this abstract book you will discover our students' demonstrated potential for exploring their unique passions, pursuing new interests, and both asking and answering profound questions. Working with extraordinary advisors, they conduct research at a level far beyond their chronological ages. In fact, several of our students have already published and presented their work at state, national, and international venues.

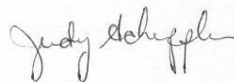
We are deeply indebted to our students' advisors. The strength of our SIR program lies with collaborative partnerships, and we are tremendously appreciative of our students' advisors and their institutions. During the past twenty-five years IMSA students have worked with thousands of advisors from hundreds of institutions, and the attention, guidance, and support they have given our students is both inspiring and humbling. We thank all the experts and leaders who join us in boldly applying innovative ways to nurture learners' talents and guide them as they reach extraordinary levels of achievement. When working together as a collective community, we have the vision, resources, and influence to shape education in ways that truly enable students to "learn how to learn" so they can confront present and future challenges that impact our local and global communities and most certainly improve the quality of life on our planet.

As you read the abstracts, we are confident that you will share our appreciation and admiration of our students' work. These young men and women have demonstrated that they take our mission seriously and are eager to tackle unsolved problems, address challenging issues, and contribute to an ever-growing body of knowledge. Working with their advisors, our students experience real-world problem solving, collaboration, and scholarship and for many, this work is a life-changing event. We trust that you will see for yourself that they are well-prepared to solve the challenges that our world will face in the future, that they are well-prepared to succeed in, or create, careers that do not yet exist and that they will, above all, strive to "advance the human condition."

Sincerely,



Glenn W. "Max" McGee, Ph.D.
President



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

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

Twenty-fifth Annual IMSAloquium

May 2, 2013

Table of Contents

Twenty-Five Years of Student Inquiry and Research	2 - 4
Student Accomplishments 2012-13.....	5 - 9
Schedule of Activities	10
Poster Session	11 - 18
Poster Session Maps	19 - 21
Time and Room Schedule for Presentations	23 - 34
Student Abstracts, Organized by Topic.....	35 - 132
• A Biochemistry	35 - 38
• B Bioengineering	39 - 42
• C Biology	43 - 58
• D Business	58 - 59
• E Chemistry	59 - 64
• F Computer Science	65 - 70
• G Economics	70 - 72
• H Education	72 - 73
• I Engineering	73 - 78
• J English	78 - 80
• K Environmental Science	80 - 85
• L History	85 - 86
• M Mathematics	86 - 89
• N Medicine	90 - 101
• O Neurobiology	101 - 116
• P Physics	117 - 124
• Q Psychology	125 - 126
• R Social Science	127 - 130
• S Space Science	130 - 131

SIR 2011-12 Summary133 - 140

Index of Student Presenters Referenced to Time, Room, and Abstract Number 141 - 146

Inside Back Cover – IMSA Map with Room Locations Highlighted

IMSAloquium cover designer is Chris Reader, IMSA staff member.
The cover was inspired by *Cytoskeleton Minicatalog 2013*, Cytoskeleton, Inc.

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

Twenty-Five 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 is about 90%. Credit is now offered for participation in SIR in the summer, and Summer SIR is growing.

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!

Authorship or Co-authorship in Publications (partial listing)

- *Analytical Biochemistry*
- *ASC Nano*
- *The Astrophysical Journal Letters*
- *Alpha Epsilon Newsletter*
- *Biology of Reproduction*
- *Ceramic Engineering Science*
- *Ceramic Transactions*
- *Circulation Research*
- *Critical Reviews in Oncology/Hematology*
- *El Conquistador (newspaper)*
- *Information Processing Letters*
- *Inorganic Chemistry*
- *Intelligent Engineering Systems Through Artificial Neural Networks*
- *Journal of the American Society for Mass Spectrometry*
- *Journal of Bone and Mineral Research*
- *Journal of Comparative Neurology*
- *Journal of Dispersion Science and Technology*
- *Journal of Experimental Secondary Science*
- *Journal of Physical Chemistry*
- *Journal of Vacuum Science and Technology B*
- *Learning and Leading with Technology*
- *Meteoritics and Planetary Science*
- *Molecular Vision*
- *Monaldi Archives of Chest Disease*
- *NATO Science Series*
- *Nature*
- *Neuroscience Research Communications*
- *The Open Virology Journal*
- *Physics in Medicine and Biology*
- *Polyhedron*
- *The Science Teacher*
- *Biographies of the Citizens of Lee County Illinois: Through the Years*
- *NCSSMST Journal*
- *Traditions, Transitions, and Technologies - Themes in Southwestern Archaeology*

“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 (partial listing)

- Adventures of the Mind Conference
- American Academy of Pediatrics
- American Association of Anatomists Regional Meeting
- American Association of Pharmaceutical Scientists
- American Chemical Society
- American Institute of Aeronautics and Astronautics
- American Physical Society
- American Psychiatric Association
- American Society of Cell Biology
- American Society of Echocardiography
- American Society of Microbiology
- 10th Annual Dabrowski Conference
- Eighth Annual Lewis Landsberg Research Day at Northwestern University
- Artificial Neural Networks Intelligent Engineering
- Aspen Conference on Perinatal Research
- Association for Chemoreception Science
- Association of Professional Sleep Societies
- Beckman Medical Research Symposium
- Conference on Smart Systems for Bridges, Structure and Highways
- Experimental Biology Meeting of the American Society of Biochemistry and Molecular Biology
- Great Lakes History Conference
- History of the Atomic Age - Chicago Historical Society
- IEEE Engineering in Medicine and Biology Society
- IEEE Nuclear Science Symposium
- Illinois Association of Gifted Children
- Illinois Section of the Mathematics Association of America
- Illinois Workshop on Regenerative Biology and Tissue Engineering
- Innovations in Medical Education
- International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication
- International LAM Research Conference
- International Signal Processing Conference
- International Students' Science Fair
- International Water Forum
- Japan Rits Super Science Fair
- Joint NSRC Workshop on Nanoparticle Science at Argonne National Laboratory

- Junior Academy of Science at AAAS
- Junior Science and Humanities Symposium
- Keystone Energy Board
- Meteorological Society Meeting
- Midwest Drosophilae Conference
- Midwest Society for Pediatric Research
- National Academy of Engineering Grand Challenges Summit
- National African American Studies Conference
- National Association of Biology Teachers
- National Conference on Undergraduate Research
- Native American Studies Conference
- NATO Network of Excellence
- NCSSSMST Student Research Symposium
- Nessel Research Forum
- Pediatric Society
- Rose-Hulman Institute of Technology Undergraduate Mathematics Conference
- Rush University Research Forum
- Sakharov Readings
- STEM Summit 2013: An Integrated Approach
- Society for Integrative and Comparative Biology
- Society for *In Vitro* Biology
- Topical Workshop on Electronics for Particle Physics
- University of Illinois at Chicago College of Dentistry Clinic and Research Day
- University of Wisconsin at Madison 2011 Synchrotron Radiation Center Users' Meeting
- WaterCon 2011
- Water Environment Federation Technical Exhibition and Conference
- World Conference on Science
- Young Women in Science and Technology

Competitions (partial listing)

- ACT-SO (Afro-Academic, Cultural, Technological and Scientific Olympics)
- American Concrete Institute's Concrete Projects Student Paper Competition
- iBioGENEius
- Intel International Science and Engineering Fair
 - 21 finalists since 2008
 - 1 fourth place (individual) category award, 1 (team) third place category award
- Intel Science Talent Search
 - 47 semi-finalists and 12 finalists since 1989
 - Finalists have placed first (1993), fifth (1998), third (1999), and second and sixth (2005)
- Jack Kavanagh Memorial Youth Baseball Research Award (Society for American Baseball Research)
- Junior Science and Humanities Symposium
- Midwest Research Competition: Positive Impact
- National History Day Competition
- Neuroscience Creativity Prize
- Neuroscience Research Prize
- Percy Julian Symposium
- Siemens Westinghouse (established 1998-99)
 - 50 regional semi-finalists resulting in 7 regional finalists and 1 national semi-finalist
- Young Epidemiology Scholars

2012-2013 Student Recognition

Please join us in the Academic Pit at 12:30 pm for our Student Recognition Ceremony

Hosted By

Dr. Glenn "Max" McGee, IMSA President

Brian Chen: Growth Characterization of Electron-Beam-Induced Silver Deposition From Liquid Precursor

Advisors: Leonidas Ocola and Ralu Divan, Argonne National Laboratory

Poster presentation at the Joint NSRC Workshop on Nanoparticle Science at Argonne National Laboratory, Nov, 5-6, 2012; Co-author of paper published in the Journal of Vacuum Science and Technology B, November 8, 2012 (L. Ocola, A. Joshi-Imr, C. Kessel, B. Chen, J. Park, D. Gosztola, and R. Divan)*

Kathleen Chinetti: Searching for Dark Matter Using Charge Coupled Devices

Advisor: Thomas Schwarz, Fermi National Accelerator Laboratory

Poster presented at STEM Summit 2013: An Integrated Approach, March 8, 2013 at Stevenson High School

Kathleen Chinetti: Benefits of Student Research Opportunities

Advisor: Judy Scheppler, Illinois Mathematics and Science Academy

Presentation at STEM Summit 2013: An Integrated Approach, March 8, 2013 at Stevenson 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

Illinois Junior Academy of Science, Region V Project Exposition Finalist¹, Yale Science and Engineering Association, Inc. Science Fair Award

Kevin Emancipator: A Population-Based Approach to Define Risks Associated with Variable Hepatitis C Treatment Response in Individuals Coinfected with Human Immunodeficiency Virus

Advisor: Sudhir Penugonda, Northwestern University

38th Annual Chicago Region Junior Science and Humanities Symposium Finalist

Kent Gang: Density Functional Theory Investigation of Silicene and Metal Adatoms

Advisors: Ron Hurlbut and Glenn "Max" McGee, Illinois Mathematics and Science Academy

Illinois Junior Academy of Science, Region V Project Exposition Finalist¹, Yale Science and Engineering Association, Inc. Science Fair Award

Siva Gangavarapu: Density Functional Theory Investigation of Silicene and Metal Adatoms

Advisors: Ron Hurlbut and Glenn "Max" McGee, Illinois Mathematics and Science Academy

Illinois Junior Academy of Science, Region V Project Exposition Finalist¹, Yale Science and Engineering Association, Inc. Science Fair Award

Anna Gupta: Building an Efficient Egg-Based Antibacterial Water Filter

Advisor: Mark Carlson, Illinois Mathematics and Science Academy

Illinois Junior Academy of Science, Region V Project Exposition Finalist¹, U.S. Army Special Award for Environmental Sciences, Stockholm Junior Water Prize Regional Certificate

Shreya Jain: Achieving Hippocampus Activation Through fMRI Tests

Advisor: Todd Parrish, Northwestern University

Midwest Research Competition: Positive Impact Finalist, April 12, 2013 at Wheeling High School; Illinois Junior Academy of Science Region V Paper Exposition Finalist¹, Best in Category Behavioral Science

Samuel Kaufman: Determining the Value of a Baseball Player

Advisor: Chris Kolar, Illinois Mathematics and Science Academy

Poster presented at STEM Summit 2013: An Integrated Approach, March 8, 2013 at Stevenson High School

Omkar Kelkar: An Analysis of Regulated and Disrupted E4BP4 Circadian Waveforms in Siberian Hamsters

Advisor: Brian Prendergast, University of Chicago

Presentation at Rits Super Science Fair, November 10-14, 2012, Kyoto, Japan

Srisha Kotlo: Analysis of Critical PKC δ Sites on Sarcomeric Protein Phosphorylation and Function

Advisors: Marcus Henze and John Solaro, University of Illinois at Chicago

38th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Illinois Junior Academy of Science Region V Project Exposition Finalist¹, Best in Category Cellular and Molecular Biology, Naval Science Award; Intel International Science and Engineering Fair Finalist²

Anna Kryczka: Achieving Hippocampus Activation Through fMRI Tests

Advisor: Todd Parrish, Northwestern University

Illinois Junior Academy of Science Region V Paper Exposition Finalist¹, Best in Category Behavioral Science

Dipen Kumar: The Effect of the Enteric Biome on Lysosomal Hydrolase Activity

Advisor: Glyn Dawson, University of Chicago

Presentation at Rits Super Science Fair, November 10-14, 2012, Kyoto, Japan

Jenny Lee: HPLC–MTT Assay: Anticancer Activity of Aqueous Garlic Extract is From Allicin

Advisor: Bao-Shiang Lee, University of Illinois at Chicago

Co-author of article in Analytical Biochemistry 436 (2013) 187–189 (Jenny Lee, Shalini Gupta, Jin-Sheng Huang, Lasanthi P. Jayathilaka, Bao-Shiang Lee)

Shelly Li: Thymoquinone Inhibits Cigarette Smoke Extract-Induced SiHa Cell Invasion

Advisor(s): Kenneth Alexander, University of Chicago

Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 13-17, 2013, in Boston, Massachusetts

Shelly Li: Effects of NF- κ B Activation on E6 Oncoprotein Expression in Head and Neck Cancer Cells

Advisor: Kenneth Alexander, University of Chicago

Siemens Competition Regional Semi-Finalist; Illinois Junior Academy of Science, Region V Project Exposition Finalist¹, Best in Category Cellular and Molecular Biology; Intel International Science and Engineering Fair Finalist²

Claire Liang: Modeling Spatial Population Dynamics of Stem Cell Lineage in Tissue Regeneration
Advisor: Youfang Cao, University of Illinois at Chicago
Presentation at 34th Annual International Conference of the IEEE EMBS, August 28 – September 1, 2012, San Diego, California. (Youfang Cao, Claire Liang, Hammad Naveed, Yingzi Li, Meng Chen, and Qing Nie)
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 13-17, 2013, in Boston, Massachusetts

David Lisk: Building an Efficient Egg-Based Antibacterial Water Filter
Advisor: Mark Carlson, Illinois Mathematics and Science Academy
Illinois Junior Academy of Science, Region V Project Exposition Finalist¹; U.S. Army Special Award for Environmental Sciences, Stockholm Junior Water Prize Regional Certificate

Anuj Marathe: Heat Shock Protein 70 Maintains Intestinal Homeostasis Through the Regulation of IL-10 Producing Regulatory T Cells
Advisors: Yunwei Wang and Eugene Chang, University of Chicago
Presentation at the 2012 American Association of Pharmaceutical Scientists Annual Meeting and Exposition, October 14-18, 2012, in Chicago
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 13-17, 2013, in Boston, Massachusetts

Anuj Marathe: Transient Therapy-related Surge in Serum Tumor Biomarkers: Characterizing Behavior and Postulating its Biologic Role
Advisors: Suneel Mundle and Mohan Chelladurai, Rush University Medical Center
Co-author of paper in Critical Reviews in Oncology/Hematology, April 2013 (SD Mundle, AS Marathe, M. Chelladurai)

Aalap Mehta: The Role of RBP2 in MCF-7 Cancer Cell Drug Resistance
Advisor: Elizaveta Benevolenskaya, University of Illinois at Chicago
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 13-17, 2013, in Boston, Massachusetts

Philip Nebres: Effect of Varying Lipid Concentration on Phase Separation in Model Cell Membrane
Advisor: Adam Hammond, University of Chicago
Illinois Junior Academy of Science Region V Paper Exposition Finalist¹, Best in Category Biochemistry/Chemistry; IJAS Region V Project Exposition Finalist¹, Best in Category Biochemistry/Chemistry

Ruchi Patel: Engineering pH Dependent Anti-Caffeine Camelid VHH and Linked VHH:VHH Through Mutagenesis
Advisor: James Horn, Northern Illinois University
38th Annual Chicago Region Junior Science and Humanities Symposium Finalist

Daniel Rosenthal: Metal-Assisted Etching of Silicon Molds for Electroforming
Advisors: Ralu Divan and Leonidas Ocola, Argonne National Laboratory
Poster presentation at the 2013 APS/CNM/EMC Users Meeting at the Argonne National Laboratory, May 6-9, 2013. (D. Rosenthal, R. Divan, K. Ogando, L.E. Ocola, D. Rosenmann, N. Moldovan)
Poster presentation at the 57th International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication, May 28-31, Nashville, Tennessee. (R. Divan, D. Rosenthal, K. Ogando, L.E. Ocola, D. Rosenmann, N. Moldovan)

Robert Schurz: Improvements to Readout Electronics for CMS Hadron Calorimeter
Advisors: Jacob Anderson, Fermi National Accelerator Laboratory
38th Annual Chicago Region Junior Science and Humanities Symposium Finalist, Chicago Region second alternate

Carrie Sha *Development of Novel Sensor to Reduce Postural Kyphosis*
Advisor: Peter Clancy, Illinois Mathematics and Science Academy
Intel Science Talent Search Semifinalist; 14th Annual Percy Julian Science Symposium Finalist³, April 20, 2013, at Oak Park and River Forest High School, Illinois

Navika Shukla: Nectin-1 Specific Entry of Herpes Simplex Virus-1 Is Sufficient for Infection of the Cornea and Viral Spread to the Trigeminal Ganglia
Advisor: Tibor Valyi-Nagy, University of Illinois at Chicago
Co-author of paper in Molecular Vision (2012) 18:2711-2716. (Navika Shukla, Vaibhav Tiwari, and Tibor Valyi-Nagy)
Poster presented at STEM Summit 2013: An Integrated Approach, March 8, 2013 at Stevenson High School

Simona Stancov: The Influence of Sugar Substitutes on Yeast Fermentation with Regards to Volume of CO₂ Produced
Advisor: Joe Traina, Illinois Mathematics and Science Academy
Poster presented at STEM Summit 2013: An Integrated Approach, March 8, 2013 at Stevenson High School

Nathan Suek: Identifying an Unknown Cyanobacterium by DNA Sequence Analysis
Advisors: Robert Haselkorn and Piotr Gornicki, University of Chicago
Siemens Competition Regional Semi-Finalist

Arjun Tambe: An Analysis of the Components of Azelaic Acid-Induced Systemic Acquired Resistance in *Arabidopsis*
Advisors: Nicolas Cecchini and Jean Greenberg, University of Chicago
38th Annual Chicago Region Junior Science and Humanities Symposium Finalist; Academy of Science Region V Paper Exposition Finalist¹, Best in Category Cellular and Molecular Biology

Stephanie Wang: A Novel Design Verifying Field Programmable Gate Arrays' Radiation-Tolerance
Advisor: Jinyuan Wu, Fermi National Accelerator Laboratory
Illinois Junior Academy of Science Region V Paper Exposition Finalist¹, Best in Category Physics, U.S. Army Special Award for Engineering; Illinois Junior Academy of Science Region V Project Exposition Finalist¹

Summer Wu: Characterization and Manipulation of Nanorods via an Applied Magnetic Field
Advisors: Vinayak Dravid and Shih-Han Lo, Northwestern University
Presentation at the American Junior Academy of Science conference at the American Association for the Advancement of Science annual conference, February 13-17, 2013, in Boston, Massachusetts

Summer Wu: Developing an A β Oligomer-Targeted MRI Probe for Diagnosis of Alzheimer's Disease
Advisors: Kirsten Viola and William Klein, Northwestern University
38th Annual Chicago Region Junior Science and Humanities Symposium Finalist

Luke Zhan: Regulation of Type II NKT Cell Cytokine Production by SLAM-Associated Protein

Advisors: Chyung-Ru Wang and Xiufang Weng, Northwestern University

Illinois Junior Academy of Science, Region V Project Exposition Finalist¹; Best in Category Cellular and Molecular Biology, Society for In Vitro Biology Award; Intel International Science and Engineering Fair Finalist²

* IMSA Alumnus, class of 2010

1) The Illinois Junior Academy of Sciences State Paper and Project Expositions are May 3 and 4, 2013 at the University of Illinois at Urbana Champaign.

2) The Intel International Science and Engineering Fair is May 12-17, 2013 in Phoenix, Arizona.

3) The Percy Julian Science Symposium is April 20, 2013 at Oak Park and River Forest High School

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

IMSALOQUIUM:
Student Investigation Showcase
May 2, 2013

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 - 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

IMS Aloquium Poster List and Presentations by Topic

Biochemistry	Title	Start Time	Room
A01Ashok Arjunakani	The Effect of Various Concentrations of Lipids and Cholesterol on Phase Changes in Membranes	09:35	A-115
A02Molly Cuka Atene Poskute	Inducing Cell Death in MCF-7 Epithelial Breast Adenocarcinoma Cells with Camptothecin	11:15	Acad Pit A-138
A03Clarreesa Hardin	The Effect of Chemical Ingredients in Cosmetics on the Viability of Breast Cancer Cells	1:20	A-115
A04Jenny Lee	Water Extract of Garlic Cloves: Preparation, Characterization, and Assessment of Oxidative Stress and Apoptosis in Mouse Colon Cancer Cells	12:55	A-155
A05Philip Nebres	The Effect of Varying Concentration Levels of Cholesterol, Sphingomyelin, and DOPC on Phase Separation in Model Cell Membranes	09:10	A-115
A06Ruchi Patel	Engineering pH Dependent Anti-Caffeine Camelid VHH and Linked VHH:VHH Through Mutagenesis	11:15	A-113
A07Sajishnu Savya Joseph Weinrich	The Effects of Fas Ligand on Apoptosis in HT-29 Colon Carcinoma Cells	10:50	Acad Pit A-138
A08Shohei Yamakawa	SAV2455 Binds Promiscuously With a Vast Array of Structurally Disparate Ligands	2:10	B-110

Bioengineering	Title	Start Time	Room
B01Emerald Fikejs	Development of Image Processing Methods to Track Sub-Cellular Organelles in Investigating Asymmetric Stem Cell Division	1:20	A-155
B02Isheng Hou	Effect of Cell Nucleus Size on Folding and Three-Dimensional Organization of Chromosomes in Human Cells	09:35	A-135
B03Claire Liang	The Comparison of the Stem Cell Spatial Population Dynamics Model to its Corresponding Non-Spatial Model for Stem Cell Lineage Studies	1:20	A-113
B04Aalap Mehta	Virtual Representation of the Rat Central Nervous System	10:00	Kids Inst E-115
B05Sreyesh Satpathy	An Exploration of the Properties of an Alloy With Improved Biocompatibility and Durability for Use in Orthopaedic and Dental Implants	10:50	A-131
B06Elizabeth Weiss	The Therapeutic Potential of the Glycogenes MGAT2, MAN1A1, and MAN2A2 for Glioblastoma Treatment	10:50	B-133

Biology	Title	Start Time	Room
C01Soham Ali	Genetic Risk Factors for Colorectal Cancer in the African American Population	10:50	A-135
C02Isiah Butler	The Effect of Hydrostatic Pressure and Resulting Transendothelial Water Flux on Intracellular Calcium Signaling	10:50	A-151
C03Zi-Ning Choo	Quantification of Virus-Like Particles in Mice Fed a Lowfat or High Milkfat Diet	1:45	A-115
C04John Deng	Detection of A β Oligomers in Alzheimer's Disease Rodent Models via Immunohistochemistry	2:10	A-121
C05Vishrut Dixit	Mechanisms of Kinesin-Driven Microtubule Sliding	12:30	A-147
C06Jonathan D'Souza Mateusz Wojtaszek	Pathways in Transforming Growth Factor- β -Induced p35 Expression in Fibrosis	10:00	A-135

Biology continued

C07	Kristy Fang Nahee Park	Physical Interactions of Regulatory Sequences Within Schizophrenia Associated MIR137 Locus	11:15	B-108
C08	Marisol Flores Estefany Guzman	Gold-Capped Zinc Oxide Nanoparticle Inhibition of Herpes Simplex Virus Type-1 Infection in HeLa Cells	2:10	B-108
C09	Ellen Gieser	The Effect of the Physical Barrier of a Small Tributary on Gene Flow of Three Avian Genera in the Congo River Watershed	09:10	A-155
C10	Shivani Goel	Exosome Uptake in Bladder Cancer Cells	11:15	Kids Inst E-115
C11	Jimmy Huang Yuanhao Wang	Methods of Quantifying Oocytes in P2 CD1 Mice	09:35	A-151
C12	Vandana Karan	The Effects of Dimethyl Fumarate on Glioma Cells	12:55	A-135
C13	Kathryn Kim Rohan Verma	Hydrogen Peroxide Production in High Nitric Oxide Adapted Human Cancer Cells Which Express Tumor Stem Cell-Like Properties	11:15	B-133
C14	Srisha Kotlo	Analysis of Critical PKC δ Sites on Sarcomeric Protein Phosphorylation and Function	10:00	A-119
C15	Maria Kuznetsov	Effects of Gestational Hormones on Free Fatty Acid Receptor 2 Expression During Pregnancy	10:25	A-155
C16	Jiwon Kwak Nitya Pariti	Molecular Cloning and the Presence of <i>MST1R</i> in Gastroesophageal Adenocarcinomas	09:10	A-151
C17	Jennifer Kwon Kenneth Yun	Construction of Pathways Involving Genes Related to Severe Congenital Neutropenia	10:50	B-108
C18	Grace Li	Morphologically Unique Marine-Derived Bacteria as a Source of Natural Product Discovery	2:10	A-131
C19	Lily Lou Ciara Wardlow	The Effect of Xanthone, <i>Artemisia absinthium</i> Extract and 6-O-angeloylplenolin on the Apoptosis Rates of Human Epithelial Breast Adenocarcinoma Cells	1:45	Acad Pit A-138
C20	Anuj Marathe	Heat Shock Protein 70 Mediates IL-10 Production Through ERK Phosphorylation	2:10	A-115
C21	Shruthi Mothkur	Effect of Ranolazine on Heart Failure Development	2:10	A-135
C22	Shreya Shanker	The Role of Multidrug Resistance Proteins in Bile Acid-Stimulated Chloride Secretion	12:30	A-131
C23	Nathan Suek	Identifying an Unknown Cyanobacterium by DNA Sequence Analysis	2:10	A-113
C24	Hannah Swerbenski	Voluntary Exercise Habits in Spinal Muscular Atrophy Model Mice and the Implications of Exercise in Disease Progression	10:25	A-121
C25	Arjun Tambe	An Analysis of the Components of Azelaic Acid-Induced Systemic Acquired Resistance in <i>Arabidopsis thaliana</i>	08:45	A-121
C26	Steven Tan	Role of Desmoglein 1 in Keratinocyte Morphology and Differentiation During Epithelial Colony Development	1:45	Kids Inst E-115
C27	Jeremy Tyszkiewicz	Inducing Apoptosis in HT-29 Colorectal Adenocarcinoma by Use of Metal Ions	1:20	Acad Pit A-138
C28	Johnny Wu	Estrogen Modulation of Prostate Epithelial Cells	10:00	B-108
C29	Luke Zhan	Regulation of Type II Natural Killer T Cell Cytokine Production by Signaling Lymphocytic Activation Molecule-Associated Protein	10:25	A-119

	Business	Title	Start Time	Room
D01	Martin Bantchev Pirapat Kitipongpatana	Creating a Metagame in Checkers	12:55	Lect Hall B-206
D02	Brennan Wakey	Testing the Efficiency of the Currency Futures Market	08:45	A-133

Chemistry	Title	Start Time	Room
E01 Matthew Deng Kent Gang Siva Gangavarapu	Density Functional Theory Investigation of Silicene and Metal Adatoms	2:10	Acad Pit A-138
E02 Ujwal Kiran	Hydrodenitrogenation Using Tantalum Single-Site Catalysts	10:00	A-121
E03 Jacob Kronenberg	Production of Antibacterial Nanoparticles for Use in Water Filters	11:15	A-119
E04 Ryan Leemans Travis Scott	Understanding and Comparing Photochromic Processes	2:10	A-119
E05 John McGuire Jeffrey Tucker	A Thermodynamic and Physical Investigation of the Heusler Alloys Fe ₂ VAl and Fe ₂ VSn	12:30	A-151
E06 Daniel Rosenthal	Fabrication of Semiconductor Nanostructures by Metal-Assisted Chemical Etching	11:15	A-121
E07 Justin Sass Yifu Zhang	The Effects of Cost on Metal-Organic Framework Efficiency	12:55	A-113
E08 Navika Shukla	A Novel Method for Drug Delivery Using Toroidal-Spiral Particles: A Potential Treatment for Cancer	1:45	A-113
E09 Aaron Yu	Synthesizing a Library of Combinatorial Catalysts on Surfaces	08:45	B-110

Computer Science	Title	Start Time	Room
F01 Advitheey Chelikani	Analyzing and Testing the Monte Carlo Algorithm in the Game of Go	10:50	A-149
F02 Ryan Eberhardt Milosz Kowal	Integrating and Simplifying Access to IMSA Information Technology Resources	1:20	Lect Hall B-206
F03 Amanda Gao Kristen Mancini	Developing a Commercial Android Application for a Nonprofit Organization	08:45	A-135
F04 Jackson Gibbons	Testing the Muon g-2 Experiment Simulation	1:20	A-133
F05 Saurabh Kumar	Viability of Speech Recognition for Online Student Assessments	08:45	A-155
F06 Mack Lee	Reusing Bandwidth to Maximize Speed and Coverage for the Growing Demand of Cellular Customers	10:50	A-133
F07 Arthur Li	Vehicle Automation During an Earthquake	1:45	A-149
F08 Jingfei Li Hyun Bin Park	Creating a Novel Back-End Database for the Open Tree of Life Project	11:15	A-151
F09 Pratyush Rustagi	Improving the Clinical Trials Process Through Efficient Collection and Storage of Protocol Elements	1:45	A-155
F10 Andrew Schell	Gathering Open Source Intelligence for Criminal Investigations	11:15	Lect Hall B-206
F11 Michael Zeng	An Algorithmic Implementation of the Bollinger Band Approximation	09:35	A-133

Economics	Title	Start Time	Room
G01 Samuel Krause	The Congressional Budget Office and Their Accuracy in Deficit Prediction	10:25	A-147
G02 Andrew Kuznetsov	Machine Learning Algorithms for Bidding in Auctions	11:15	B-116
G03 Christine Liu Ashley Radee Heidi Warning	National Oil Companies	09:10	A-149
G04 Phuong Vo	How Does the Ineffectiveness of Greek Government Contribute to the European Crisis?	09:35	A-149

Education	Title	Start Time	Room
H01 Ashima Gupta	How to Change the World: Redefining Effective Assessment Practices of Twenty-First Century Skills in Specialized Domestic and International Secondary Schools	08:45	Acad Pit A-138
H02 Anton Karpovich	The Effect of Religiosity Upon the Enacted Curricula of Illinois High Schools	10:50	Lect Hall B-206

Engineering	Title	Start Time	Room
I01 Michael Adams Daniel Francis Jennifer Hoelzer	An Exploration Into Altitude and Ascent Rate Control System Design in High Altitude Balloons	09:10	A-133
I02 Kendell Byrd	Advancing Communication for the Disabled	09:10	Kids Inst E-115
I03 Brian Chien	Evolving the Touch Pad to Create New Environments	1:45	A-131
I04 Evan Derse	Decreasing Noise Produced by Wind Turbine Blades While Preserving Efficiency	10:00	Acad Pit A-138
I05 Claire Hensley	Investigating and Evaluating Roller Coaster Propulsion and Energetics	1:20	A-119
I06 Valerie Moore	The Design and Development of a Stair Climbing Robot	08:45	Kids Inst E-115
I07 Sreyesh Satpathy	Design and Analysis of a Low Speed Solar Vehicle That Effectively Functions in a Rural or Suburban Environment	11:15	A-131
I08 Stephanie Wang	A Novel Design for Measuring Field Programmable Gate Array Radiation Tolerance	08:45	A-119
I09 Stephanie Wang	Automatic Compensation for Cable Time Delay in Field Programmable Gate Arrays	09:10	A-119
I10 Kevin Zhang	Trapezoidal Clocking in Maintaining Isochronous Circuits	12:55	B-133

English	Title	Start Time	Room
J01 Kirstyn Carlson	Science Fiction and Fantasy Genre Devices Allow Authors' Self-Expression	11:15	A-149
J02 Alexander Johnson	The Methods of Characterization and Plot Development of an Adult Level Science Fiction Novel	09:10	B-110
J03 Anna Melberg	Blood Money: Death, Financial Gain, and Morality in the Gothic Novel	10:25	A-149
J04 Addison Schwaller	The Written Aspect Analysis of Performance Poetry	2:10	A-147

Environmental Science	Title	Start Time	Room
K01 Simone Alexandrova Marco Medina	The Effects of Brand Name Root Stimulants Versus Their Active Ingredients on Germinated Corn Plants	2:10	B-133
K02 Lydia Auch Grace DiCecco Kenzo Esquivel	A Comparison in Environmental Education: Aurora, Illinois and Beijing, China	09:10	Acad Pit A-138
K03 Sarah Blanco Clare Leahy	Increasing Diversity in the Illinois Mathematics and Science Academy Prairie: Preliminary Findings	09:10	Lect Hall B-206
K04 Anna Gupta David Lisk	Building an Efficient Egg-Based Antibacterial Water Filter	10:50	A-119
K05 Anna Kryczka	Investigating the Feasibility of Green Roofs for Residential Applications	1:45	A-119

Environmental Science continued

K06 Earl Justin Mangulabnan Scott Zelman	Influence of the Media on the Public Perception of Alternative Energy	2:10	A-149
K07 Anthony Ortiz	Sustaining Plant Growth With an LED Array	1:45	A-147
K08 Shreya Santhanam	Enumeration of Microorganisms in Anaerobic Digesters Using Fluorescent <i>In Situ</i> Hybridization	09:10	A-147
K09 Samuel Walder	Engineering a Better Phytoremediator	09:35	Acad Pit A-138

History	Title	Start Time	Room
L01 Nathan Huxtable	Examining Radical Ideology Among Immigrant Workers in Gilded Age and Progressive Era Chicago	10:50	A-147
L02 Jameson O'Reilly	A Study on the Universality of the Universal Declaration of Human Rights	10:00	A-149

Mathematics	Title	Start Time	Room
M01 Andrew Alonso- Emanuel	Model of the Spread of West Nile Virus Outbreaks in the United States Based on Rate of Human Incidences	09:35	B-133
M02 Lael Costa	Understanding the Dimensions of String Theory: The Betti Numbers of Calabi-Yau Manifolds	1:45	A-135
M03 Kevin He	Using Geometry to Parameterize Rational Solutions to Algebraic Equations	11:15	A-133
M04 Samuel Kaufman Matthew Tennenhouse	Predicting a Breakout Season for Major League Baseball Players	09:35	Kids Inst E-115
M05 Evan Li	Asymmetric Nature of Wireless Communications	1:45	B-110
M06 Suraj Sinha	The Application of Markov Chains in Granite Formations	1:20	Kids Inst E-115

Medicine	Title	Start Time	Room
N01 Prachi Aggarwal Jenson Phung Shreya Santhanam	Examining Asthma Prevalence and Improving Medication Access in Chicago Public Schools	10:00	A-147
N02 Charlene Angeles	The Impact of Narcolepsy on Self-Image and Quality of Life in Young Adults	12:55	A-133
N03 Ryan Chiu	Uncovering the Role of PTEN in Mediating the Decrease of Pancreatic Inflammation Signals by Omega-3 Fatty Acids	09:35	A-155
N04 Kevin Emancipator Gina Liu	A Population-Based Approach to Define Risks Associated with Variable Hepatitis C Treatment Response in Individuals Coinfected with Human Immunodeficiency Virus	08:45	A-115
N05 Arjun Garg	The Role of Serum Free Light Chain Assays for Diagnosis and Monitoring of Myeloma	08:45	A-151
N06 Aaron Geldner	Poloxamer 188 as a Repair for Apoptosis	10:00	A-151
N07 Annika Gomez	Healthcare Providers' Motivations for Hand Hygiene Compliance	10:50	A-155
N08 Tejas Joshi	Elucidating Gastrokine Function in NSAID-Induced Inflammation via Myeloperoxidase Staining	09:35	B-108
N09 Kaylee Kauffman	Retrospective Analysis of Pediatric Patients With Chronic Graft-Versus-Host Disease Concerning Predisposing Factors, Response to Therapy, Survival, and Outcome	10:50	B-110
N10 Akram Khaja	Studying the Mechanisms Through Which NKG2D Receptor Stimulation Induces CD8 T-cell Survival in the Tumor Environment	08:45	B-116
N11 Anna Krzywiec	Characterizing Melanoma Stem Cell Responses to 8-OH-DPAT	1:20	B-110

Medicine continued

N12 Shannon Kurian Monica Patel	Characterizing Methicillin-Resistant <i>Staphylococcus aureas</i> Isolates in a Cohort of Newborn Infants	12:55	B-110
N14 Shelly Li	Effects of NF- κ B Activation on E6 Oncoprotein Expression in Head and Neck Cancer Cells	10:00	A-115
N15 Viveka Patel	Characterizing Patents on Discoveries From Genome-Wide Association Studies	2:10	A-133
N16 Joseph Reda	An Analysis of the Efficacy of SPECT Scans as Both a Predictor and Measure of Change in Patients of Hyperbaric Oxygen Therapy	12:55	A-115
N17 Sankeerth Reddy Sunny Shah	Effectiveness of Commonly Used Medical Smartphone Applications in Correctly Diagnosing Diseases	10:25	B-116
N18 Hannah Sambor	Using Task Shifting as a Model to Improve Injury and Trauma Care in Sub-Saharan Africa	10:25	B-110
N19 Frances Seo	Correlation of Gestational Age and Independent Oral Feeding in Preterm Newborns	11:15	A-135
N20 Ross Skelly	A Prospective Outcome of Condensed Polytetrafluoroethylene Mesh in Non-Sterile Abdominal Wall Defects	10:25	B-108
N21 Sai Talluru	The Experience of <i>GATA6</i> Mutations of All Subjects in the Monogenic Diabetes Registry	10:00	B-133
N22 Shruti Topudurti Selam Zenebe-Gete	Discovering New Chemokine Agonist Receptor Drugs	10:50	Kids Inst E-115

Neurobiology	Title	Start Time	Room
O01 Ashok Arjunakani	Changes in Hippocampal Volume Between Patients With Alzheimer's Disease and Other Cognitive States	10:25	A-113
O02 Gary Chen Dipen Kumar	Acoustical and Optical Amplitude Modulated Signals in the Inferior Colliculus of the Midbrain	09:10	B-133
O03 Kathleen Chinetti	The Effect of Early Maternal Care on Recovery From Febrile Seizures in <i>Cx3cr1^{GFP}</i> Mice Pups	10:50	B-116
O04 Anastasia Fafara Brianna Pusey	Partial Recollection as a Unique Memory Type and Corresponding Brain Activity	12:30	Kids Inst E-115
O05 Kent Gang Deborah Park	Investigating the Effects of <i>ALS2</i> and <i>SOD1</i> in the Upper Motor Neurons	10:25	Acad Pit A-138
O06 Stephanie Hatz	Exploring Brain Mechanisms Underlying Aversion to Nicotine	12:55	A-119
O07 Kevin Hong Matthew Park	Effects of Alzheimer's Disease on Ribbon Synapses in the dSR Region of Mouse Disease Models	1:20	B-133
O08 Shreya Jain Anna Kryczka	Achieving Hippocampus Activation Through fMRI Tests	10:50	A-115
O09 Omkar Kelkar	The Circadian and Melatonin-Dependent Regulation of <i>e4bp4</i> mRNA Expression in Siberian Hamsters (<i>Phodopus sungorus</i>)	09:10	A-113
O10 Omkar Kelkar Amy Zhu	The Effect of Combined Donepezil and Memantine Treatment on Hippocampal Subiculum and CA1 in Alzheimer's Disease Patients	09:35	A-113
O11 Nishita Kumar Jackson Michuda	Identifying the Target Genes of TDP-43 Regulated miRNAs and Their Correlation With Neurodegeneration	1:45	B-133
O12 Lakhena Leang Xueyang Ren	Progressive Interactions Between Amyotrophic Lateral Sclerosis-Related FUS Mutant and Protein Chaperones	1:45	Lect Hall B-206
O13 Jessica Lee	Differences Between the Inhibition of Cholinesterase and Acetylcholinesterase	2:10	A-151

Neurobiology continued

O14	Judy Li	Analysis of Glial Activation in R6/2-YFP Mice: A Novel Mouse Model for the Analysis of Axonal Degeneration	08:45	A-147
O15	Emily Ling Hye Jean Yoon	Developing Therapeutic Approaches to Neurodegenerative Diseases Associated With Defects in RNA-Binding Proteins	2:10	Lect Hall B-206
O16	Sarah Martin	Role of Mutant SOD1 Molecules as Membrane Active Elements in Amyotrophic Lateral Sclerosis Pathology	12:30	Lect Hall B-206
O17	Shivani Patel	Expression and Detection of the Ion Channel GABA _A Receptor Subunits $\alpha 1$ and $\gamma 2$ in HEK293 Cells	12:30	B-108
O18	Yvette Ramirez Michelle Wiebe	Poor Sleep Quality in the Elderly and How it Affects Cognitive Functioning	1:45	A-133
O19	Vignesh Ravi	The Effect of Cortical Thickness, Hippocampal Subfield Measures, and Hippocampal Volume on the Discrimination Power of Alzheimer's Disease Patients	10:50	A-113
O20	Devin Scott Jennifer Zhang	How Concrete and Abstract Words are Processed With Different Magnitudes Within the Brain	09:35	A-121
O21	Carrie Sha	Effects of Visualization on Long Term Memory in Epileptic Patients	09:10	A-121
O22	Medha Singh Lynette To	Biochemical Studies of Estrogen Receptor Protein Interactions in the Hippocampus of Rats	11:15	A-155
O23	Vimig Socrates	Audio-Tactile Interactions in Texture Perception in Humans	1:20	A-147
O24	Saigopal Somasundaram Sarah Valentine	Combinatorial Preconditioning of a Neuronal Cell Line With Low Ethanol and Resveratrol to Achieve Neuroprotective Upregulation of Focal Adhesion Kinase and its Phosphorylated Form	08:45	B-133
O25	Summer Wu	Developing an A β Oligomer-Targeted MRI Probe for Diagnosis of Alzheimer's Disease	1:45	A-121
O26	Ellen Zhao	Observing Neuron Projections in Mice Brains That Can Be Targeted When Treating Parkinson's Disease	1:20	B-108

	Physics	Title	Start Time	Room
P01	Wesley Beck	Determining the Future for Finding the Neutrino Mass Hierarchy	12:55	A-121
P02	Sharadyn Ciota	Searching for Dark Matter Using Charge-Coupled Devices	1:45	A-151
P03	Youcef Hadjarab Kevin Li Woohyun Shin	Optimizing Energy Resolution in a Prototype PET Imager	09:10	A-131
P04	Youcef Hadjarab Kevin Li	Improving Coordinate Resolution in Positron Emission Tomography Detectors	09:35	A-131
P05	Emily Lindgren	Kaon Production by a 120 GeV/c Proton Beam With a Bismuth Target	1:20	A-151
P06	Sagar Punhani	Neutrino Oscillations: Real-World Applications on the Digital World	1:20	A-121
P07	Benjamin Rabe	The Search for Standard Model Higgs Events in Associated WH Production Resulting in the b anti-b Decay Channel With D \emptyset Data	10:00	B-110
P08	Robert Schurz	Improvements to Readout Electronics for Compact Muon Selenoid Hadron Calorimeter	10:25	A-115
P09	Abhishek Sethi	Analysis of Two Theories to Account for Observed Variations in the Rate of Radioactive Decay	1:45	B-108
P10	Woohyun Shin	Effects of Spatial Resolution on the Temperature Profile of a FLASH Thermonuclear Flame Model	08:45	A-131
P11	Lee Tang	Modeling the Structural Properties of Superconducting Magnets	09:10	B-116
P12	Lia Vallina	Construction of a Solenoid Magnet to Cancel the Effects of a Magnetic Field	12:55	Kids Inst E-115
P13	Joshua Wu	A Measurement of Zero: Simulating a Superconducting Inflector Magnet	10:00	A-113
P14	William Xu	Quantum Mechanical Analysis and Control of Plasmonic Wave Packets in Silver Nanowires	10:25	Kids Inst E-115
P15	Oleksandr Yarema	Comparative Study of the Impact of Differing Progenitor Evolution on Core-Collapse Supernova Explosions	10:25	A-131

Psychology	Title	Start Time	Room
Q01 Vivian Chau	Effects of Childhood Trauma on the Adult Brain	1:20	A-131
Q02 Michelle Kinama Colette Moos Tony Vadakumchery	An Investigation Into the Relationship Between Evolutionary Processes and Artificial Intelligence	2:10	Kids Inst E-115
Q03 Sophie Legan Cristina Menchaca	Descriptive Assessment of Social Norms at the Illinois Mathematics and Science Academy	10:25	Lect Hall B-206
Q04 June Qian	Impulsivity and Subjective Response to the Stimulating and Sedative Effects of Alcohol	09:35	B-110

Social Science	Title	Start Time	Room
R01 Jacob Akstins Carissa Lao	Illinois Mathematics and Science Academy Students' Perceptions of Lesbian, Gay, Bisexual, Transgender, and Questioning Community Acceptance at IMSA and at Their Former Schools	09:35	Lect Hall B-206
R02 Harrison Dimmig	Relationships Between Energy Interests, Agriculture, and the Environment in Contemporary America	09:35	A-147
R03 Rebecca Kleina Gregory O'Bannon	Descriptive Assessment of Peer Influence Upon Attending the Illinois Mathematics and Science Academy	10:00	Lect Hall B-206
R04 Hankyul Lee	Strategy and Tactics of Ancient Warfare From 499 BCE to 14 CE	08:45	A-149
R05 Anthony John Marquez Erma Mladenova	The Distinct Rhetorical Tendencies of Democrats and Republicans	1:20	A-149
R06 Karen Olowu Isabella West	The Implications of Gender and Culture on Body Image	08:45	Lect Hall B-206
R07 Arjun Sarode	Investigating the Portrayal and Comparison of Stereotypes Between Japanese and Western Media	09:35	B-116

Space Science	Title	Start Time	Room
S01 Jonathan Hu Steven Kosvick	The Frequency of Exoplanets Around Stars	2:10	A-155
S02 Mohamed Kady	Mining of Precious Metals From Near-Earth Asteroids	10:00	A-133

Poster Map Cafeteria

A01	A07	B05	C05	C11	C17
A02	A08	B06	C06	C12	C18
A03	B01	C01	C07	C13	C19
A04	B02	C02	C08	C14	C20
A05	B03	C03	C09	C15	C21
A06	B04	C04	C10	C16	C22

C23	C24	C25	C26	C27	C28	C29	D01	D02	E01	E02	E03	E04	E05
E06	E07	E08	E09	F01	F02	F03	F04	F05	F06	F07	F08	F09	F10

F11	G01	G02	G04	H01	H02	I01	I02	I03	I04	I05	I06	I07	I08	I09	I10	J01	J02
J03	J04	K01	K02	K03	K04	K05	K06	K07	K08	K09	L01	L02	M01	M02	M03	M04	M05

M06
N01
N02
N03

N04	N05	N06	N07	N08	N09	N10	N11	N12	N13	N14	N15	N16	N17	N18	N19
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

N20	N21
-----	-----

Old Cafeteria/Commons

N22

Diagram Not to Scale

<ul style="list-style-type: none"> * Biochemistry: A01-A08 * Bioengineering: B01-B06 * Biology: C01-C29 * Business: D01-D02 * Chemistry: E01-E09 * Computer Science: F01-F11 	<ul style="list-style-type: none"> * Economics: G01-G04 * Education: H01-H02 * Engineering: I01-I10 * English: J01-J04 * Environmental Science: K01-K09 * History: L01-L02 	<ul style="list-style-type: none"> * Mathematics: M01-M06 * Medicine: N01-N22
--	--	---

Science Atrium

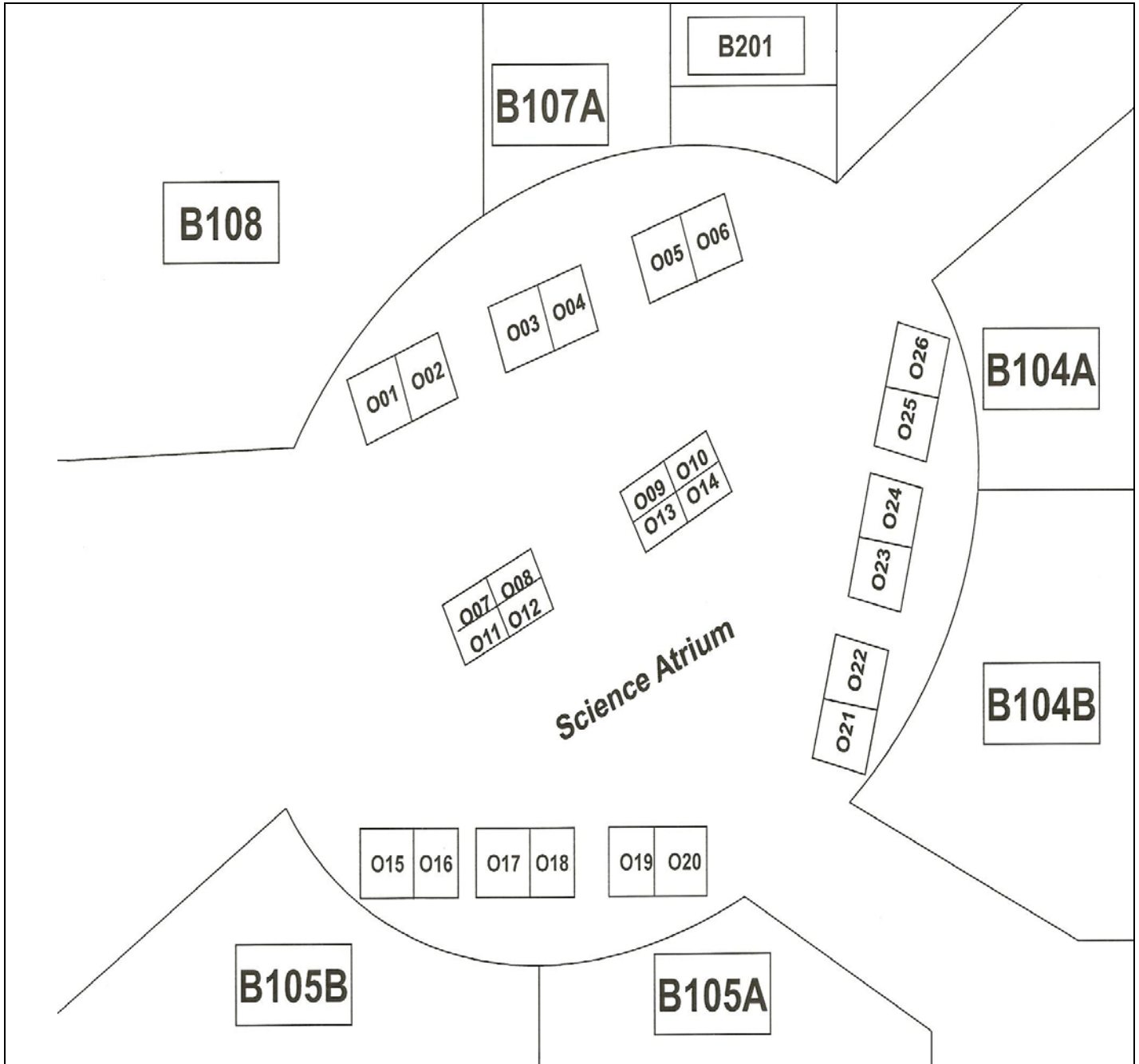
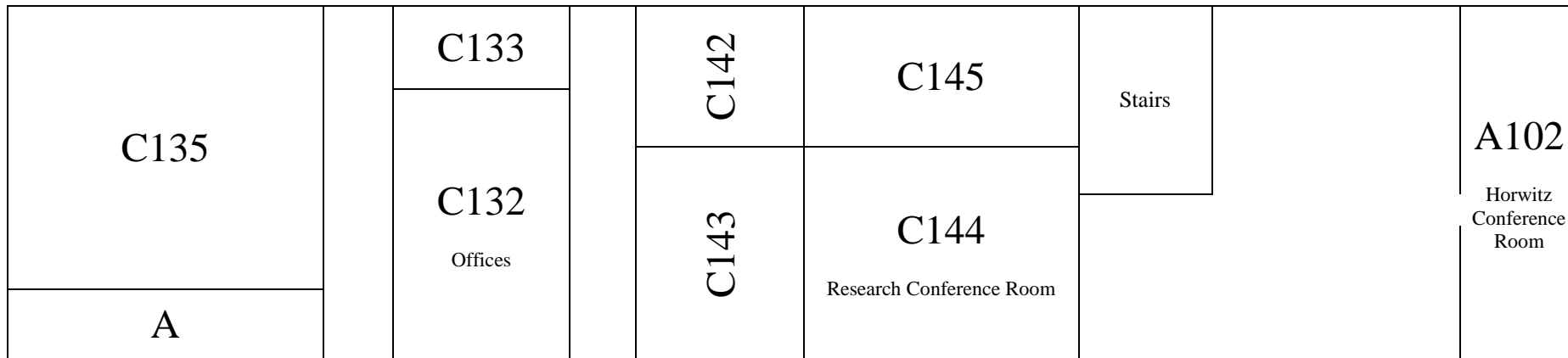


Diagram not to Scale

* Neurobiology: O01-O26

Posters - Hall Between Administrative Offices and Student Life



P01	P02	P03	P04	P05	P06	P07	P08
P15	Q01	Q02	Q03	Q04	R01	R02	R03

P09	P10	P11	P12	P13	P14
R04	R05	R06	R07	S01	S02

Hall between Administrative Offices and Student Life

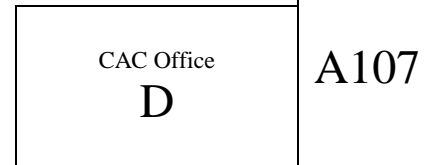
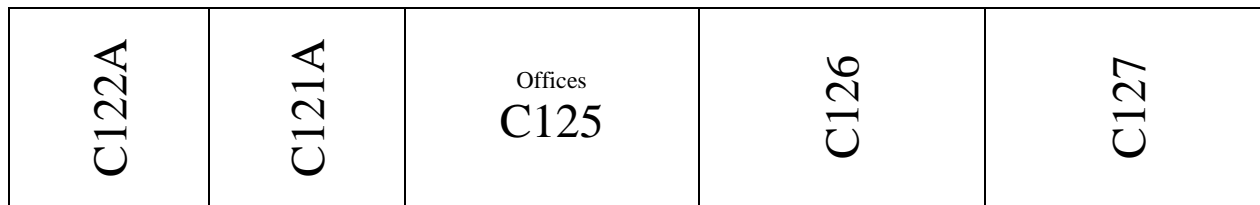


Diagram not to Scale

* Physics: P01-P15
 * Psychology: Q01-Q04
 * Social Science: R01-R07
 * Space Science: S01-S02

Time and Room Schedule for Presentations

08:45 - 9:00

Room	Poster ID	
A-115	N04	A Population-Based Approach to Define Risks Associated with Variable Hepatitis C Treatment Response in Individuals Coinfected with Human Immunodeficiency Virus Kevin Emancipator, Gina Liu, Sudhir Penugonda
A-119	I08	A Novel Design for Measuring Field Programmable Gate Array Radiation Tolerance Stephanie Wang, Jinyuan Wu
A-121	C25	An Analysis of the Components of Azelaic Acid-Induced Systemic Acquired Resistance in <i>Arabidopsis thaliana</i> Arjun Tambe, Nicolas Cecchini
A-131	P10	Effects of Spatial Resolution on the Temperature Profile of a FLASH Thermonuclear Flame Model Woohyun Shin, Sean Couch, George Jordan, Don Lamb
A-133	D02	Testing the Efficiency of the Currency Futures Market Brennan Wakey, Doug Adams
A-135	F03	Developing a Commercial Android Application for a Nonprofit Organization Amanda Gao, Kristen Mancini, Debbi Daniel-Wayman, John Hayward, Alissa Maas
A-147	O14	Analysis of Glial Activation in R6/2-YFP Mice: A Novel Mouse Model for the Analysis of Axonal Degeneration Judy Li, Rodolfo Gatto, Gerardo Morfini
A-149	R04	Strategy and Tactics of Ancient Warfare From 499 BCE to 14 CE Hankyul Lee, Lee Eysturlid
A-151	N05	The Role of Serum Free Light Chain Assays for Diagnosis and Monitoring of Myeloma Arjun Garg, Sairah Alvi
A-155	F05	Viability of Speech Recognition for Online Student Assessments Saurabh Kumar, Joseph Dvorak
Acad. Pit A-138	H01	How to Change the World: Redefining Effective Assessment Practices of Twenty-First Century Skills in Specialized Domestic and International Secondary Schools Ashima Gupta, Glenn "Max" McGee
B-110	E09	Synthesizing a Library of Combinatorial Catalysts on Surfaces Aaron Yu, Guoliang Liu, Chad Mirkin, Sarah Petrosko
B-116	N10	Studying the Mechanisms Through Which NKG2D Receptor Stimulation Induces CD8 T-cell Survival in the Tumor Environment Akram Khaja, Jose Alejandro Guevara
B-133	O24	Combinatorial Preconditioning of a Neuronal Cell Line With Low Ethanol and Resveratrol to Achieve Neuroprotective Upregulation of Focal Adhesion Kinase and its Phosphorylated Form Saigopal Somasundaram, Sarah Valentine, Michael Collins, Donald Dosch, Robyn Fischer, Kwang Hoon Moon, Nazhath Tajuddin
Kids Inst. E-115	I06	The Design and Development of a Stair Climbing Robot Valerie Moore, James Gerry
Lect. Hall B-206	R06	The Implications of Gender and Culture on Body Image Karen Olowu, Isabella West, Kathryn Grubbs

9:10 - 9:25

Room	Poster ID	
A-113	O09	The Circadian and Melatonin-Dependent Regulation of <i>e4bp4</i> mRNA Expression in Siberian Hamsters (<i>Phodopus sungorus</i>) Omkar Kelkar, Kenneth Onishi, Brian Prendergast, Tyler Stevenson
A-115	A05	The Effect of Varying Concentration Levels of Cholesterol, Sphingomyelin, and DOPC on Phase Separation in Model Cell Membranes Philip Nebres, Adam Hammond
A-119	I09	Automatic Compensation for Cable Time Delay in Field Programmable Gate Arrays Stephanie Wang, Jinyuan Wu
A-121	O21	Effects of Visualization on Long Term Memory in Epileptic Patients Carrie Sha, Vernon Leo Towle
A-131	P03	Optimizing Energy Resolution in a Prototype PET Imager Youcef Hadjarab, Kevin Li, Woohyun Shin, Pavel Murat
A-133	I01	An Exploration Into Altitude and Ascent Rate Control System Design in High Altitude Balloons Michael Adams, Daniel Francis, Jennifer Hoelzer, Geza Gyuk, Ken Walczak
A-147	K08	Enumeration of Microorganisms in Anaerobic Digesters Using Fluorescent <i>In Situ</i> Hybridization Shreya Santhanam, Krishna Pagilla, Jai Prakash
A-149	G03	National Oil Companies Christine Liu, Ashley Radee, Heidi Warning, Lee Eysturlid
A-151	C16	Molecular Cloning and the Presence of <i>MST1R</i> in Gastroesophageal Adenocarcinomas Jiwon Kwak, Nitya Pariti, Daniel Catenacci
A-155	C09	The Effect of the Physical Barrier of a Small Tributary on Gene Flow of Three Avian Genera in the Congo River Watershed Ellen Gieser, Shannon Hackett
Acad. Pit A-138	K02	A Comparison in Environmental Education: Aurora, Illinois and Beijing, China Lydia Auch, Grace DiCecco, Kenzo Esquivel, Glenn "Max" McGee, Aracelys Rios
B-108	N13	Using Complete Blood Count as a Marker of Neonatal Sepsis and Line Infections in Neonates Joshua Lam, Hamzah Miltaha, Maliha Shareef
B-110	J02	The Methods of Characterization and Plot Development of an Adult Level Science Fiction Novel Alexander Johnson, Erin Micklo
B-116	P11	Modeling the Structural Properties of Superconducting Magnets Lee Tang, Tengming Shen, Ryuji Yamada
B-133	O02	Acoustical and Optical Amplitude Modulated Signals in the Inferior Colliculus of the Midbrain Gary Chen, Dipen Kumar, Claus-Peter Richter
KI E-115	I02	Advancing Communication for the Disabled Kendell Byrd, James Gerry
LH B-206	K03	Increasing Diversity in the Illinois Mathematics and Science Academy Prairie: Preliminary Findings Sarah Blanco, Clare Leahy, Jean Bigger, Donald Dosch

9:35 - 9:50

Room	Poster ID	
A-113	O10	The Effect of Combined Donepezil and Memantine Treatment on Hippocampal Subiculum and CA1 in Alzheimer's Disease Patients Omkar Kelkar, Amy Zhu, Lei Wang
A-115	A01	The Effect of Various Concentrations of Lipids and Cholesterol on Phase Changes in Membranes Ashok Arjunakani, Adam Hammond
A-121	O20	How Concrete and Abstract Words are Processed With Different Magnitudes Within the Brain Devin Scott, Jennifer Zhang, Vernon Leo Towle
A-131	P04	Improving Coordinate Resolution in Positron Emission Tomography Detectors Youcef Hadjarab, Kevin Li, Pavel Murat
A-133	F11	An Algorithmic Implementation of the Bollinger Band Approximation Michael Zeng, Doug Adams, Sergiy Mesropyan, Dennis Wang
A-135	B02	Effect of Cell Nucleus Size on Folding and Three-Dimensional Organization of Chromosomes in Human Cells Isheng Hou, Gamze GURSOY, Jie Liang
A-147	R02	Relationships Between Energy Interests, Agriculture, and the Environment in Contemporary America Harrison Dimmig, Claiborne Skinner
A-149	G04	How Does the Ineffectiveness of Greek Government Contribute to the European Crisis? Phuong Vo, Christian Nokkentved
A-151	C11	Methods of Quantifying Oocytes in P2 CD1 Mice Jimmy Huang, Yuanhao Wang, Takeshi Kurita, Vanida Serna
A-155	N03	Uncovering the Role of PTEN in Mediating the Decrease of Pancreatic Inflammation Signals by Omega-3 Fatty Acids Ryan Chiu, Paul Grippo
Acad. Pit A-138	K09	Engineering a Better Phytoremediator Samuel Walder, Glenn "Max" McGee, Aracelys Rios
B-108	N08	Elucidating Gastrokine Function in NSAID-Induced Inflammation via Myeloperoxidase Staining Tejas Joshi, David Boone, Wes Grimm
B-110	Q04	Impulsivity and Subjective Response to the Stimulating and Sedative Effects of Alcohol June Qian, Harriet de Wit, Jessica Weafer
B-116	R07	Investigating the Portrayal and Comparison of Stereotypes Between Japanese and Western Media Arjun Sarode, Jonathan Besancon
B-133	M01	Model of the Spread of West Nile Virus Outbreaks in the United States Based on Rate of Human Incidences Andrew Alonso-Emanuel, Donald Dosch, Richard Stalmack
Kids Inst. E-115	M04	Predicting a Breakout Season for Major League Baseball Players Samuel Kaufman, Matthew Tennenhouse, Christopher Kolar
Lect. Hall B-206	R01	Illinois Mathematics and Science Academy Students' Perceptions of Lesbian, Gay, Bisexual, Transgender, and Questioning Community Acceptance at IMSA and at Their Former Schools Jacob Akstins, Carissa Lao, David Evenson

10:00 - 10:15

Room	Poster ID	
A-113	P13	A Measurement of Zero: Simulating a Superconducting Inflector Magnet Joshua Wu, Brendan Kiburg
A-115	N14	Effects of NF-κB Activation on E6 Oncoprotein Expression in Head and Neck Cancer Cells Shelly Li, Kenneth Alexander
A-119	C14	Analysis of Critical PKCδ Sites on Sarcomeric Protein Phosphorylation and Function Srisha Kotlo, Marcus Henze, John Solaro
A-121	E02	Hydrodenitrogenation Using Tantalum Single-Site Catalysts Ujwal Kiran, Randall Meyer
A-133	S02	Mining of Precious Metals From Near-Earth Asteroids Mohamed Kady, Mark Hammergren
A-135	C06	Pathways in Transforming Growth Factor-β-Induced p35 Expression in Fibrosis Jonathan D'Souza, Mateusz Wojtaszek, Roberta Marangoni, Jun Wei
A-147	N01	Examining Asthma Prevalence and Improving Medication Access in Chicago Public Schools Prachi Aggarwal, Jenson Phung, Shreya Santhanam, Ashley Dyer, Ruchi Gupta, Chris Warren, Emily Zadikoff
A-149	L02	A Study on the Universality of the Universal Declaration of Human Rights Jameson O'Reilly, Christian Nokkentved
A-151	N06	Poloxamer 188 as a Repair for Apoptosis Aaron Geldner, Lisa Hoffman, Rapheal Lee
Acad. Pit A-138	I04	Decreasing Noise Produced by Wind Turbine Blades While Preserving Efficiency Evan Derse, Branson Lawrence, Glenn "Max" McGee
B-108	C28	Estrogen Modulation of Prostate Epithelial Cells Johnny Wu, Dan-Ping (Grace) Hu, Wen-Yang Hu, Gail Prins, Guang-Bin Shi
B-110	P07	The Search for Standard Model Higgs Events in Associated WH Production Resulting in the b anti-b Decay Channel With Dϕ Data Benjamin Rabe, Ryuji Yamada
B-133	N21	The Experience of GATA6 Mutations of All Subjects in the Monogenic Diabetes Registry Sai Talluru, Graeme Bell, David Carmody, Siri Atma Greeley
Kids Inst. E-115	B04	Virtual Representation of the Rat Central Nervous System Aalap Mehta, Andreas Linninger, Indu Venugopal
Lect. Hall B-206	R03	Descriptive Assessment of Peer Influence Upon Attending the Illinois Mathematics and Science Academy Rebecca Kleina, Gregory O'Bannon, David Evenson

10:25 - 10:40

Room	Poster ID	
A-113	O01	Changes in Hippocampal Volume Between Patients With Alzheimer's Disease and Other Cognitive States Ashok Arjunakani, Lei Wang
A-115	P08	Improvements to Readout Electronics for Compact Muon Selenoid Hadron Calorimeter Robert Schurz, Jacob Anderson
A-119	C29	Regulation of Type II Natural Killer T Cell Cytokine Production by Signaling Lymphocytic Activation Molecule-Associated Protein Luke Zhan, Chyung-Ru Wang, Xiufang Weng
A-121	C24	Voluntary Exercise Habits in Spinal Muscular Atrophy Model Mice and the Implications of Exercise in Disease Progression Hannah Swerbenski, Joey Cardona, Christine DiDonato
A-131	P15	Comparative Study of the Impact of Differing Progenitor Evolution on Core-Collapse Supernova Explosions Oleksandr Yarema, Sean Couch, George Jordan, Don Lamb
A-147	G01	The Congressional Budget Office and Their Accuracy in Deficit Prediction Samuel Krause, Eric Smith
A-149	J03	Blood Money: Death, Financial Gain, and Morality in the Gothic Novel Anna Melberg, Adam Kotlarczyk
A-155	C15	Effects of Gestational Hormones on Free Fatty Acid Receptor 2 Expression During Pregnancy Maria Kuznetsov, Brian Layden
Acad. Pit A-138	O05	Investigating the Effects of <i>ALS2</i> and <i>SOD1</i> in the Upper Motor Neurons Kent Gang, Deborah Park, Pembe Hande Ozdinler
B-108	N20	A Prospective Outcome of Condensed Polytetrafluoroethylene Mesh in Non-Sterile Abdominal Wall Defects Ross Skelly, Jing Liu
B-110	N18	Using Task Shifting as a Model to Improve Injury and Trauma Care in Sub-Saharan Africa Hannah Sambor, Stacey Chamberlain
B-116	N17	Effectiveness of Commonly Used Medical Smartphone Applications in Correctly Diagnosing Diseases Sankeerth Reddy, Sunny Shah, Susan Styer
Kids Inst. E-115	P14	Quantum Mechanical Analysis and Control of Plasmonic Wave Packets in Silver Nanowires William Xu, Meishan Zhao
Lect. Hall B-206	Q03	Descriptive Assessment of Social Norms at the Illinois Mathematics and Science Academy Sophie Legan, Cristina Menchaca, David Evenson

10:50 - 11:05

Room	Poster ID	
A-113	O19	The Effect of Cortical Thickness, Hippocampal Subfield Measures, and Hippocampal Volume on the Discrimination Power of Alzheimer's Disease Patients Vignesh Ravi, Lei Wang
A-115	O08	Achieving Hippocampus Activation Through fMRI Tests Shreya Jain, Anna Kryczka, Todd Parrish
A-119	K04	Building an Efficient Egg-Based Antibacterial Water Filter Anna Gupta, David Lisk, Mark Carlson
A-131	B05	An Exploration of the Properties of an Alloy With Improved Biocompatibility and Durability for Use in Orthopaedic and Dental Implants Sreyesh Satpathy, Christos Takoudis
A-133	F06	Reusing Bandwidth to Maximize Speed and Coverage for the Growing Demand of Cellular Customers Mack Lee, Randall Berry, Vijay Subramanian
A-135	C01	Genetic Risk Factors for Colorectal Cancer in the African American Population Soham Ali, Nathan Ellis
A-147	L01	Examining Radical Ideology Among Immigrant Workers in Gilded Age and Progressive Era Chicago Nathan Huxtable, Eric Smith
A-149	F01	Analyzing and Testing the Monte Carlo Algorithm in the Game of Go Advitheey Chelikani, Phadmakar Patankar
A-151	C02	The Effect of Hydrostatic Pressure and Resulting Transendothelial Water Flux on Intracellular Calcium Signaling Isiah Butler, Randal Dull
A-155	N07	Healthcare Providers' Motivations for Hand Hygiene Compliance Annika Gomez, Emily Mawdsley
Acad. Pit A-138	A07	The Effects of Fas Ligand on Apoptosis in HT-29 Colon Carcinoma Cells Sajishnu Savya, Joseph Weinrich, Robyn Fischer, Glenn "Max" McGee
B-108	C17	Construction of Pathways Involving Genes Related to Severe Congenital Neutropenia Jennifer Kwon, Kenneth Yun, Seth Corey
B-110	N09	Retrospective Analysis of Pediatric Patients With Chronic Graft-Versus-Host Disease Concerning Predisposing Factors, Response to Therapy, Survival, and Outcome Kaylee Kauffman, Morris Kletzel
B-116	O03	The Effect of Early Maternal Care on Recovery From Febrile Seizures in <i>Cx3cr1^{GFP}</i> Mice Pups Kathleen Chinetti, Sookyong Koh
B-133	B06	The Therapeutic Potential of the Glycogenes MGAT2, MAN1A1, and MAN2A2 for Glioblastoma Treatment Elizabeth Weiss, Roger Kroes
Kids Inst. E-115	N22	Discovering New Chemokine Agonist Receptor Drugs Shruti Topudurti, Selam Zenebe-Gete, Richard Miller, Andrew Shum
Lect. Hall B-206	H02	The Effect of Religiosity Upon the Enacted Curricula of Illinois High Schools Anton Karpovich, Deborah Scarano

11:15 - 11:30

Room	Poster ID	
A-113	A06	Engineering pH Dependent Anti-Caffeine Camelid VHH and Linked VHH:VHH Through Mutagenesis Ruchi Patel, James Horn
A-119	E03	Production of Antibacterial Nanoparticles for Use in Water Filters Jacob Kronenberg, Mark Carlson
A-121	E06	Fabrication of Semiconductor Nanostructures by Metal-Assisted Chemical Etching Daniel Rosenthal, Ralu Divan, Leonidas Ocola
A-131	I07	Design and Analysis of a Low Speed Solar Vehicle That Effectively Functions in a Rural or Suburban Environment Sreyesh Satpathy, Dayal Parthi
A-133	M03	Using Geometry to Parameterize Rational Solutions to Algebraic Equations Kevin He, Izzet Coskun
A-135	N19	Correlation of Gestational Age and Independent Oral Feeding in Preterm Newborns Frances Seo, Jonathan Muraskas, Sarah Van Nostrand
A-149	J01	Science Fiction and Fantasy Genre Devices Allow Authors' Self-Expression Kirstyn Carlson, Tracy Townsend
A-151	F08	Creating a Novel Back-End Database for the Open Tree of Life Project Jingfei Li, Hyun Bin Park, Richard Ree
A-155	O22	Biochemical Studies of Estrogen Receptor Protein Interactions in the Hippocampus of Rats Medha Singh, Lynette To, Nino Tabatadze, Catherine Woolley
Acad. Pit A-138	A02	Inducing Cell Death in MCF-7 Epithelial Breast Adenocarcinoma Cells with Camptothecin Molly Cuka, Atene Poskute, Robyn Fischer, Glenn "Max" McGee
B-108	C07	Physical Interactions of Regulatory Sequences Within Schizophrenia Associated MIR137 Locus Kristy Fang, Nahee Park, Jubao Duan, Catherine Leites
B-116	G02	Machine Learning Algorithms for Bidding in Auctions Andrew Kuznetsov, Jason Hartline
B-133	C13	Hydrogen Peroxide Production in High Nitric Oxide Adapted Human Cancer Cells Which Express Tumor Stem Cell-Like Properties Kathryn Kim, Rohan Verma, Kim Elseth, Aqil Madeeha, James Radosevich
Kids Inst. E-115	C10	Exosome Uptake in Bladder Cancer Cells Shivani Goel, Carrie Franzen, Gopal Gupta
Lect. Hall B-206	F10	Gathering Open Source Intelligence for Criminal Investigations Andrew Schell, James Bondi, Brad Carnduff

12:30 - 12:45

Room	Poster ID	Poster Title
A-131	C22	The Role of Multidrug Resistance Proteins in Bile Acid-Stimulated Chloride Secretion Shreya Shanker, Jada Domingue, Mrinalini Rao, Jayashree Sarathy
A-147	C05	Mechanisms of Kinesin-Driven Microtubule Sliding Vishrut Dixit, Vladimir Gelfand
A-151	E05	A Thermodynamic and Physical Investigation of the Heusler Alloys Fe₂VAl and Fe₂VSn John McGuire, Jeffrey Tucker, Philip Nash
B-108	O17	Expression and Detection of the Ion Channel GABA_A Receptor Subunits α1 and γ2 in HEK293 Cells Shivani Patel, Kaouther Ajroud, Dane Chetkovich
Kids Inst. E-115	O04	Partial Recollection as a Unique Memory Type and Corresponding Brain Activity Anastasia Fafara, Brianna Pusey, Joel Voss
Lect. Hall B-206	O16	Role of Mutant SOD1 Molecules as Membrane Active Elements in Amyotrophic Lateral Sclerosis Pathology Sarah Martin, Michael Allen, Ana Correa

12:55 - 1:10

Room	Poster ID	Poster Title
A-113	E07	The Effects of Cost on Metal-Organic Framework Efficiency Justin Sass, Yifu Zhang, Randall Snurr, Emmanouil Tyllianakis
A-115	N16	An Analysis of the Efficacy of SPECT Scans as Both a Predictor and Measure of Change in Patients of Hyperbaric Oxygen Therapy Joseph Reda, August Martinucci, Patricia Reda
A-119	O06	Exploring Brain Mechanisms Underlying Aversion to Nicotine Stephanie Hatz, Daniel McGehee, Shannon Wolfman
A-121	P01	Determining the Future for Finding the Neutrino Mass Hierarchy Wesley Beck, Maury Goodman
A-133	N02	The Impact of Narcolepsy on Self-Image and Quality of Life in Young Adults Charlene Angeles, Mary Kapella
A-135	C12	The Effects of Dimethyl Fumarate on Glioma Cells Vandana Karan, David Braun, Douglas Feinstein
A-155	A04	Water Extract of Garlic Cloves: Preparation, Characterization, and Assessment of Oxidative Stress and Apoptosis in Mouse Colon Cancer Cells Jenny Lee, Shalini Gupta, Jinsheng Huang, Lasanthi Jayathilaka, Bao-Shiang Lee
B-110	N12	Characterizing Methicillin-Resistant <i>Staphylococcus aureas</i> Isolates in a Cohort of Newborn Infants Shannon Kurian, Monica Patel, Bill Kabat
B-133	I10	Trapezoidal Clocking in Maintaining Isochronous Circuits Kevin Zhang, Jin Wu
Kids Inst. E-115	P12	Construction of a Solenoid Magnet to Cancel the Effects of a Magnetic Field Lia Vallina, Thomas Gadfort
Lect. Hall B-206	D01	Creating a Metagame in Checkers Martin Bantchev, Pirapat Kitipongpatana, Donald Porzio

1:20 - 1:35

Room	Poster ID	
A-113	B03	The Comparison of the Stem Cell Spatial Population Dynamics Model to its Corresponding Non-Spatial Model for Stem Cell Lineage Studies Claire Liang, Youfang Cao
A-115	A03	The Effect of Chemical Ingredients in Cosmetics on the Viability of Breast Cancer Cells Clarreesa Hardin, Anita White
A-119	I05	Investigating and Evaluating Roller Coaster Propulsion and Energetics Claire Hensley, Peter Clancy
A-121	P06	Neutrino Oscillations: Real-World Applications on the Digital World Sagar Punhani, Maury Goodman
A-131	Q01	Effects of Childhood Trauma on the Adult Brain Vivian Chau, Royce Lee
A-133	F04	Testing the Muon g-2 Experiment Simulation Jackson Gibbons, Adam Lyon
A-147	O23	Audio-Tactile Interactions in Texture Perception in Humans Vimig Socrates, Sliman Bensmaia
A-149	R05	The Distinct Rhetorical Tendencies of Democrats and Republicans Anthony John Marquez, Erma Mladenova, Tracy Townsend
A-151	P05	Kaon Production by a 120 GeV/c Proton Beam With a Bismuth Target Emily Lindgren, Brendan Casey
A-155	B01	Development of Image Processing Methods to Track Sub-Cellular Organelles in Investigating Asymmetric Stem Cell Division Emerald Fikejs, Chi Bang, Jun Cheng
Acad. Pit A-138	C27	Inducing Apoptosis in HT-29 Colorectal Adenocarcinoma by Use of Metal Ions Jeremy Tyszkiewicz, Robyn Fischer, Glenn "Max" McGee
B-108	O26	Observing Neuron Projections in Mice Brains That Can Be Targeted When Treating Parkinson's Disease Ellen Zhao, Savio Chan
B-110	N11	Characterizing Melanoma Stem Cell Responses to 8-OH-DPAT Anna Krzywiec, Jonathan Eby, Caroline Le Poole, Kristin Willenborg
B-133	O07	Effects of Alzheimer's Disease on Ribbon Synapses in the dSR Region of Mouse Disease Models Kevin Hong, Matthew Park, Dan Nicholson
Kids Inst. E-115	M06	The Application of Markov Chains in Granite Formations Suraj Sinha, Somak Dutta, Debashis Mondal
Lect. Hall B-206	F02	Integrating and Simplifying Access to IMSA Information Technology Resources Ryan Eberhardt, Milosz Kowal, Ralph Flickinger, Steven Terrell, Fred Yankowski

1:45 - 2:00

Room	Poster ID	
A-113	E08	A Novel Method for Drug Delivery Using Toroidal-Spiral Particles: A Potential Treatment for Cancer Navika Shukla, Ying Liu, Vishal Sharma
A-115	C03	Quantification of Virus-Like Particles in Mice Fed a Lowfat or High Milkfat Diet Zi-Ning Choo, Eugene Chang
A-119	K05	Investigating the Feasibility of Green Roofs for Residential Applications Anna Kryczka, Peter Clancy
A-121	O25	Developing an Aβ Oligomer-Targeted MRI Probe for Diagnosis of Alzheimer's Disease Summer Wu, William Klein, Kirsten Viola
A-131	I03	Evolving the Touch Pad to Create New Environments Brian Chien, J. Edward Colgate
A-133	O18	Poor Sleep Quality in the Elderly and How it Affects Cognitive Functioning Yvette Ramirez, Michelle Wiebe, Kathryn Reid
A-135	M02	Understanding the Dimensions of String Theory: The Betti Numbers of Calabi-Yau Manifolds Lael Costa, Eric Zaslow
A-147	K07	Sustaining Plant Growth With an LED Array Anthony Ortiz, Jason Fatten, Will Healy, Margi Werderich
A-149	F07	Vehicle Automation During an Earthquake Arthur Li, Namrata Pandya
A-151	P02	Searching for Dark Matter Using Charge-Coupled Devices Sharadyn Ciota, Juan Estrada
A-155	F09	Improving the Clinical Trials Process Through Efficient Collection and Storage of Protocol Elements Pratyush Rustagi, Samuel Volchenbom
Acad. Pit	C19	The Effect of Xanthone, <i>Artemisia absinthium</i> Extract and 6-O-angeloylplenolin on the Apoptosis Rates of Human Epithelial Breast Adenocarcinoma Cells Lily Lou, Ciara Wardlow, Robyn Fischer, Glenn "Max" McGee
A-138		
B-108	P09	Analysis of Two Theories to Account for Observed Variations in the Rate of Radioactive Decay Abhishek Sethi, Thomas Kroc
B-110	M05	Asymmetric Nature of Wireless Communications Evan Li, Peng-Jun Wan
B-133	O11	Identifying the Target Genes of TDP-43 Regulated miRNAs and Their Correlation With Neurodegeneration Nishita Kumar, Jackson Michuda, Jane Wu
Kids Inst. E-115	C26	Role of Desmoglein 1 in Keratinocyte Morphology and Differentiation During Epithelial Colony Development Steven Tan, Kathleen Green, Oxana Nekrasova
Lect. Hall B-206	O12	Progressive Interactions Between Amyotrophic Lateral Sclerosis-Related FUS Mutant and Protein Chaperones Lakhena Leang, Xueyang Ren, Richard Morimoto, Anan Yu

2:10 - 2:25

Room	Poster ID	
A-113	C23	Identifying an Unknown Cyanobacterium by DNA Sequence Analysis Nathan Suek, Piotr Gornicki, Robert Haselkorn
A-115	C20	Heat Shock Protein 70 Mediates IL-10 Production Through ERK Phosphorylation Anuj Marathe, Eugene Chang, Yunwei Wang
A-119	E04	Understanding and Comparing Photochromic Processes Ryan Leemans, Travis Scott, Peter Clancy, Anita White
A-121	C04	Detection of Aβ Oligomers in Alzheimer's Disease Rodent Models via Immunohistochemistry John Deng, Himanshi Desai, William Klein, Pascale Lacor
A-131	C18	Morphologically Unique Marine-Derived Bacteria as a Source of Natural Product Discovery Grace Li, Skylar Carlson, Brian Murphy, Mark Sadek
A-133	N15	Characterizing Patents on Discoveries From Genome-Wide Association Studies Viveka Patel, Brandon Pierce
A-135	C21	Effect of Ranolazine on Heart Failure Development Shruthi Mothkur, Andrew Wasserstrom
A-147	J04	The Written Aspect Analysis of Performance Poetry Addison Schwaller, Daniel Gleason
A-149	K06	Influence of the Media on the Public Perception of Alternative Energy Earl Justin Mangulabnan, Scott Zelman, Robert Kiely
A-151	O13	Differences Between the Inhibition of Cholinesterase and Acetylcholinesterase Jessica Lee, Changiz Geula
A-155	S01	The Frequency of Exoplanets Around Stars Jonathan Hu, Steven Kosvick, Jacob Bean
Acad. Pit A-138	E01	Density Functional Theory Investigation of Silicene and Metal Adatoms Matthew Deng, Kent Gang, Siva Gangavarapu, Ron Hurlbut, Glenn "Max" McGee
B-108	C08	Gold-Capped Zinc Oxide Nanoparticle Inhibition of Herpes Simplex Virus Type-1 Infection in HeLa Cells Marisol Flores, Estefany Guzman, Thessicar Antoine, Deepak Shukla
B-110	A08	SAV2455 Binds Promiscuously With a Vast Array of Structurally Disparate Ligands Shohei Yamakawa, Sharrol Bachas
B-133	K01	The Effects of Brand Name Root Stimulants Versus Their Active Ingredients on Germinated Corn Plants Simone Alexandrova, Marco Medina, Julie Polz
Kids Inst. E-115	Q02	An Investigation Into the Relationship Between Evolutionary Processes and Artificial Intelligence Michelle Kinama, Colette Moos, Tony Vadakumchery, Mike Ososky
Lect. Hall B-206	O15	Developing Therapeutic Approaches to Neurodegenerative Diseases Associated With Defects in RNA-Binding Proteins Emily Ling, Hye Jean Yoon, Jane Wu

A01**The Effect of Various Concentrations of Lipids and Cholesterol on Phase Changes in Membranes****Presenter(s)**

Ashok Arjunakani, Illinois Mathematics and Science Academy

Advisor(s)

Adam Hammond, University of Chicago

While many important investigations have been undertaken for understanding the cell, very little is still known about the lipids that compose its membranes. Lipids have many interesting traits, such as being able to create membranes by themselves, going through changes that mimic thermodynamic phases. In this investigation three lipids, cholesterol, sphingomyelin and dioleoylphosphatidyl-choline (DOPC), were used to make vesicles and were observed to see if they underwent phase changes. Once the vesicles were created they were sonicated. Fluorescence resonance energy transfer (FRET) was used to observe the finished vesicles to look for phase changes. It was found that the vesicles with the most DOPC had the least FRET and therefore had the most phase changes. All the other vesicles were more due to a less amount of DOPC. From this it was concluded that the more DOPC in a vesicle the more phase changes that can occur.

A02**Inducing Cell Death in MCF-7 Epithelial Breast Adenocarcinoma Cells with Camptothecin****Presenter(s)**

Molly Cuka, Illinois Mathematics and Science Academy
Atene Poskute, Illinois Mathematics and Science Academy

Advisor(s)

Robyn Fischer, Illinois Mathematics and Science Academy
Glenn "Max" McGee, Illinois Mathematics and Science Academy

Camptothecin, a DNA damager, was used to induce apoptosis in the breast cancer cell line MCF-7. An enzyme-linked immunosorbant assay (ELISA) was run to determine the effect of this chemical on apoptosis, or programmed cell death. Whether apoptosis occurred was recorded based on the presence of cleaved caspase-3. The procedure involved splitting the cell line into a plate of 24 (4x6) wells and adding 1.0 M, 0.8M, 0.6 M, and 0.4 M solutions of camptothecin. These dilutions were made by dissolving solid camptothecin into dimethyl sulfoxide (DMSO). Since the DMSO could potentially affect the cells, a control group with just DMSO was run in comparison as well as a control containing only medium. Cells were exposed to camptothecin for 24 hours. The results of the ELISA test were not as expected. Results will be drawn conclusively after further testing. Then it will be evident which concentrations are most effective in inducing apoptosis.

A03**The Effect of Chemical Ingredients in Cosmetics on the Viability of Breast Cancer Cells****Presenter(s)**

Clarreesa Hardin, Illinois Mathematics and Science Academy

Advisor(s)

Anita White, Illinois Mathematics and Science Academy

Consumers may be concerned that chemical ingredients in cosmetics may have a negative effect on people with breast cancer by stimulating growth of their cancerous cells. Two common ingredients found in cosmetics are guar gum and polyvinyl alcohol. This study is designed to test the effects of different concentrations of these chemical ingredients on MCF7 breast cancer cells. Cell viability was assessed in a 96 well plate using the MTT assay procedure, after five day incubation with the compounds. Preliminary results suggest no effects of guar gum on the cells at all concentrations tested whereas polyvinyl alcohol was cytotoxic at all concentrations. Although polyvinyl alcohol is typically not ingested by consumers, these results warrant further investigation. If we were to gain information regarding a link between chemical ingredients in cosmetics and the growth of breast cancer cells, this could impact cosmetic companies all over the world. Safety precautions can take place.

A04**Water Extract of Garlic Cloves: Preparation, Characterization, and Assessment of Oxidative Stress and Apoptosis in Mouse Colon Cancer Cells****Presenter(s)**

Jenny Lee, Illinois Mathematics and Science Academy

Advisor(s)

Shalini Gupta, University of Illinois at Chicago

Jinsheng Huang, University of Illinois at Chicago

Lasanthi Jayathilaka, University of Illinois at Chicago

Bao-Shiang Lee, University of Illinois at Chicago

Allium sativum, or garlic, has been shown to reduce the risk of cancer in various epidemiological data. However, the optimal methods of preparation, anticancer activity, and the signaling pathways of garlic extracts (GE) are still largely unclear. In this study, we examined the best methods of preparation of the extract, the characteristics of the active compounds, and the methods through which garlic extracts induce apoptosis. The results demonstrated that GE maintains activity best at temperatures below 4°C and at slightly acidic conditions. In addition, we found that allicin, a sulfur-based biochemical molecule, is responsible for the potency of GE. These results were corroborated by reversed-phase high-performance liquid chromatography and thin layer chromatography analysis of the isolated active compound in GE and pure allicin. Finally, our results indicated that garlic extracts induce apoptosis through a reactive oxygen species-based pathway, because treatment with garlic correlated with a high increase in oxidative stress. Interestingly, treatment by garlic extracts disturbed the expression of many proteins associated with cancer; for example, heat shock protein 60 (HSP60) and HSP90, which are linked to cell regulation and apoptosis, are downregulated in cells exposed to garlic.

A05**The Effect of Varying Concentration Levels of Cholesterol, Sphingomyelin, and DOPC on Phase Separation in Model Cell Membranes****Presenter(s)**

Philip Nebres, Illinois Mathematics and Science Academy

Advisor(s)

Adam Hammond, University of Chicago

Cell membranes form a barrier between the interior and exterior of the cell and therefore are critical in communication within the cell's environment. The membrane contains lipids that can exist in various phases. These phases affect cell functions like signal transduction, lateral sorting, and drug interaction. Due to difficulty in directly observing cell membranes, model cell membranes are created to mimic the behavior of the cell membrane. A phase diagram is usually employed to display the various combinations of lipids in a model cell membrane. This experiment focused on various combinations of two solutions, one solution with a molar ratio of 1:1:1 of cholesterol, sphingomyelin, and dioleoylphosphatidylcholine (DOPC) and another solution with a 1:1 molar ratio of cholesterol and sphingomyelin. The mixtures were sonicated to create small unilamellar vesicles, a model cell membrane. Fluorescence resonance energy transfer (FRET) analysis was used to determine if phase separation occurs at various combinations of the two solutions. FRET is a molecular ruler that can be used to determine the distance between two molecules. Results show that the mixture of the two solutions resulting to the lowest cholesterol concentration created phase separation. The results are attributed to the unique characteristics of cholesterol and how it mixes with other lipids.

A06**Engineering pH Dependent Anti-Caffeine Camelid VHH and Linked VHH:VHH Through Mutagenesis****Presenter(s)**

Ruchi Patel, Illinois Mathematics and Science Academy

Advisor(s)

James Horn, Northern Illinois University

There is great interest in the development of new methods to manipulate affinity reagents, such as antibodies. Camelids have a unique class of heavy chain only antibodies that possess a single binding domain, called VHH. We explored two methods to modify/engineer a model VHH antibody with anti-caffeine properties. The first approach was to generate a tandem anti-caffeine VHH variant which linked two analogous VHH domains (to facilitate VHH dimerization). Since the linking region would likely play a role in the final structure, this objective entailed testing different length linkers to determine the optimum length that would allow the production of monobodies. The resultant variants were analyzed with size exclusion chromatography. These results suggested the ratio of diabodies to monobodies decreased as the linker length increased. Currently, a longer 7X linker is being tested to determine whether it produces 100% monomeric VHH. The second approach was to create and test engineered pH-dependent binding anti-caffeine VHH variants. Quick change mutagenesis and isothermal titration calorimetry were used to generate and evaluate the engineered variants, respectively. Preliminary results revealed some variants developed pH dependency. The creation of pH dependent anti-caffeine variants suggests the approach may be applicable to other antibody-target interactions.

A07**The Effects of Fas Ligand on Apoptosis in HT-29 Colon Carcinoma Cells****Presenter(s)**

Sajishnu Savya, Illinois Mathematics and Science Academy
Joseph Weinrich, Illinois Mathematics and Science Academy

Advisor(s)

Robyn Fischer, Illinois Mathematics and Science Academy
Glenn "Max" McGee, Illinois Mathematics and Science Academy

Fas ligand is a membrane protein that can initiate apoptosis, also known as programmed cell death. HT-29 cells are colon carcinoma cells that are able to resist apoptosis in cell culture conditions. By inducing the Fas receptor in HT-29 cells, we investigated whether apoptosis can be induced in cancer cells. Fas receptor was induced by exposing the cells to a Fas ligand environment for 24 hours. We used three different concentrations of Fas ligand, 0.2 μ g/L, 0.1 μ g/L, and 0.5 μ g/L. Finally, we ran a Western blot in order to detect apoptosis activity in the cell by measuring the amounts of cleaved caspase-3, a protein vital to initiating the apoptosis pathway. Our results are yet to be determined. If apoptosis is successfully initiated in our HT-29 cells, this will show that in these cells the Fas ligand pathway is inducible, and could indicate a viable external treatment for colon cancer.

A08**SAV2455 Binds Promiscuously With a Vast Array of Structurally Disparate Ligands****Presenter(s)**

Shohei Yamakawa, Illinois Mathematics and Science Academy

Advisor(s)

Sharrol Bachas, Johns Hopkins University

Many species of bacteria have adopted mechanisms of antimicrobial resistance against constituents of the human immune system. Resistance can be battled by studying the characteristics of binding affinity between the resistant pathogen and receptor. To elucidate how these regulator proteins can undergo polyspecific binding, bound proteins can be monitored with green fluorescence. Crystal structures determined from X-ray diffraction with these same ligands are also being solved to determine ligand positions and orientations. Pymol software was used to visualize proteins and identify characteristics such as folding sequence and elements consisting of each amino acid. Line segment visualization was used to observe the primary and secondary structures, while ribbon visualization was used to observe the quaternary structure. Results indicate that SAV2455 (an *S. aureus* protein) folds into a dimer of the SHS2 domain. The binding pocket of SAV2455 is composed of a concave of aromatic residues and one pair of aliphatic residues that act as pincers. In the binding pocket, there are also three aspartate and glutamate residues that allow the cationic ligands to bind. These results show that SAV2455 binds ligands in the multidrug-resistance set with a modest range of binding affinities, considering their diverse structures.

B01

Development of Image Processing Methods to Track Sub-Cellular Organelles in Investigating Asymmetric Stem Cell Division

Presenter(s)

Emerald Fikejs, Illinois Mathematics and Science Academy

Advisor(s)

Chi Bang, University of Illinois at Chicago

Jun Cheng, University of Illinois at Chicago

It is important to track the dynamic migration patterns of proteins and sub-cellular organelles in live cells in order to understand how their dynamic characteristics correlates with cellular processes and organism development. Utilizing time-lapse live-imaging techniques and customized tracking programs (developed with Labview and Matlab), the migration patterns of centrosomes and spectrosomes, sub-cellular organelles in the germline stem cells, were semi-automatically tracked to reveal dynamic parameters such as velocity, spindle angular velocity, spindle angle, and distance, which are used to examine the organelles' role in regulating the asymmetric stem cell division. Three main aspects of the tracking program were successfully developed to optimize the tracking results: 1) digital image processing techniques were implemented to enhance the clarity/contrast of overlaid images from multiple optical sections (Matlab); 2) the tracking program was modified to prevent already tracked organelles from being mistaken for, and resultingly tracked in place of, desired organelles (Labview); and 3) overall programs were further automated to decrease user intervention and reduce human error. Furthermore, the developed tracking programs can be generally applied to characterize sub-cellular dynamics in other systems in four-dimensional image sequences.

B02

Effect of Cell Nucleus Size on Folding and Three-Dimensional Organization of Chromosomes in Human Cells

Presenter(s)

Isheng Hou, Illinois Mathematics and Science Academy

Advisor(s)

Gamze GURSOY, University of Illinois at Chicago

Jie LIANG, University of Illinois at Chicago

Global architecture and spatial organization of chromosomes play critical roles in gene expression, regulation, and human diseases, including cancer. The three-dimensional structure of chromosomes shows differences between normal and diseased cells. Single-cell imaging and chromosome capture-based techniques provide information on chromosome conformations and their spatial organizations across different cells and in different developmental stages. Computational modeling can provide insights into the mechanisms of chromosome organization. We developed a polymer model to study the higher-order chromosome organization in the human cell nucleus. Our model is based on the generation of self-avoiding polymer chains of chromosomes in a confined spherical space. We generated 10,000 independent conformations in six different confinement sizes to mimic different cells in different developmental stages. Each generated polymer chain is composed of 250 monomers with a fiber diameter of 30nm and a persistence length of 150 nm. The average chromosome scaling behavior captured from our modeling in differentiated cells as well as in stem cells agrees with experimental observations. Our study shows that the size of the confinement due to different cell nuclei affects the structural features of the human chromosomes, which might be required for the expression and regulation of cell-specific genes.

B03**The Comparison of the Stem Cell Spatial Population Dynamics Model to its Corresponding Non-Spatial Model for Stem Cell Lineage Studies****Presenter(s)**

Claire Liang, Illinois Mathematics and Science Academy

Advisor(s)

Youfang Cao, University of Illinois at Chicago

Computational models can provide insight on the control mechanisms of stem cell lineage development, which is critical for advancement in biology and human health. The proliferation and differentiation of intermediate cells are activated and inhibited by different cytokines, which are molecules produced by differentiated cells and are spatially diffused to certain distances to act on stem cells and progenitor cells. The spatial information of cells and diffusion of cytokines usually go ignored in deterministic population dynamics models. We have developed a stochastic stem cell spatial population dynamics model in which spatial information of each cell and inhibition ranges of different cytokines are explicitly modeled. In this work, we aim to show the advantages of spatial population dynamics in studying the homeostatic tissue size control problem involving stem cell lineages. We have also developed a non-spatial ordinary differential equations (ODE) model based on our spatial model, solved using the Runge-Kutta method. Through numerical simulations with different parameters, we show that two models will produce the same behaviors when the diffusion ranges of cytokines are infinity. However, in situations where cytokines only diffuse locally to short distances, which is usually the case, the spatial population dynamics model is more accurate than the non-spatial ODE model.

B04**Virtual Representation of the Rat Central Nervous System****Presenter(s)**

Aalap Mehta, Illinois Mathematics and Science Academy

Advisor(s)

Andreas Linninger, University of Illinois at Chicago

Indu Venugopal, University of Illinois at Chicago

The difficulty in delivering drugs within the central nervous system is a major problem in terms of treatment. In order to better understand the delivery and distribution of drugs within this system, a virtual model of a female Sprague-Dawley rat central nervous system (CNS) was created using data gathered from T2-weighted magnetic resonance images. The masks and surface meshes of this model were generated by using Mimics software and the volume meshes were generated by using 3-Matic software. As the focus of this project has been to understand the delivery and distribution of drugs via the intrathecal route of administration, the cerebrospinal fluid space within the rat CNS has been modeled. Such volume meshes can be easily used in computational fluid dynamics software for understanding the delivery and distribution of various types of drug formulations.

B05**An Exploration of the Properties of an Alloy With Improved Biocompatibility and Durability for Use in Orthopaedic and Dental Implants****Presenter(s)**

Sreyesh Satpathy, Illinois Mathematics and Science Academy

Advisor(s)

Christos Takoudis, University of Illinois at Chicago

Research was done to determine the properties of oxidized TiAl6V4 to analyze its potential use in future orthopaedic and dental implants. The surface needed to be modified to promote osseointegration, reducing the chance of implant failure allowing the use of a strong, biocompatible material to construct long-lasting implants. The samples were thermally oxidized in a furnace at different temperatures starting at 200 °C and increasing in intervals of 100 °C up to 700 °C, giving a mixture of different crystalline structures of TiO₂ (amorphous, anatase, and rutile) with a focus on the production of the most biocompatible, anatase. Both rough and smooth samples were used, and two samples at each temperature for three hours. Goniometry was used to determine the contact angle, which indicated hydrophilicity. The composition of the sample was observed with fourier-transformation infrared spectroscopy. Future research will involve testing with *in vitro* cells and lab mice to guarantee biocompatibility before case studies begin.

B06**The Therapeutic Potential of the Glycogenes MGAT2, MAN1A1, and MAN2A2 for Glioblastoma Treatment****Presenter(s)**

Elizabeth Weiss, Illinois Mathematics and Science Academy

Advisor(s)

Roger Kroes, Northwestern University

Glioblastomas are very serious and highly invasive brain tumors with no known cure. It has been found that the tumor stem cells within the gliomas cause the reoccurrence of the cancer following therapy. Using microarrays and quantitative reverse transcriptase polymerase chain reactions, glycogene expression patterns from four types of stem cells isolated from patients' gliomas were determined. The genes analyzed defined glycosylation patterns of the four different classes of stem cell lines. From the 2592 possible genes analyzed, three were found to have significantly differential expression. These were MGAT2, MAN 1A1, and MAN2A2, all responsible for core oligosaccharide structure formation. The genes MGAT2 and MAN1A1 exhibited markedly different expression between the highly aggressive mesenchymal lines and the less invasive classical and proneural lines. Thus, modulation of their expression may have therapeutic potential. It was found that the gene MGAT2 was expressed at 1.21 fold higher levels in mesenchymal than in proneural I and that the MAN1A1 gene was expressed at 1.30 fold higher levels in the mesenchymal than in proneural I lines. The glycogenes encoding MGAT2 and MAN1A1 have the most therapeutic potential and will be further tested to determine if they can be used for gene therapy to modulate the invasivity of glioblastomas.

C01

Genetic Risk Factors for Colorectal Cancer in the African American Population

Presenter(s)

Soham Ali, Illinois Mathematics and Science Academy

Advisor(s)

Nathan Ellis, University of Illinois at Chicago

The aim of this project is to identify genetic risk factors for colorectal cancer (CRC) in African Americans that also indicate risk for the disease in Caucasians. Recent Genome Wide Association Studies have shown that significant single nucleotide polymorphisms (SNPs) indicating CRC risk in Caucasians are not found in African Americans. However, African Americans have the highest CRC risk among all ethnic groups in the United States, and so I filtered a list of SNPs using a program called Haploview to narrow down the list of SNPs. I filtered them to find SNPs with low frequency (less than 5%), but high correlation factors ($r^2 > 0.8$). I then ran these SNPs through a program on the Sequenom website to design a primer assay. Using this design, I ordered primers for the SNPs, and prepared them in two plates, one of which would contain 368 DNA samples from CRC cases, and another which would contain 368 DNA samples from controls. After amplifying the DNA samples through PCR, I sent the plates to the Sequenom lab to check the presence of the SNPs in the DNA. I am currently waiting for the results to arrive from that lab. Once I get the results, I will analyze the difference between the percent of SNPs found in the cases versus the controls, and I hope to find a significant difference between the two groups.

C02

The Effect of Hydrostatic Pressure and Resulting Transendothelial Water Flux on Intracellular Calcium Signaling

Presenter(s)

Isiah Butler, Illinois Mathematics and Science Academy

Advisor(s)

Randal Dull, University of Illinois at Chicago

Intracellular calcium regulates the synthesis of endothelial nitric oxide synthase (eNOS), which plays a role in many biological processes, including the body's inflammatory response to injuries resulting in edema. eNOS also controls vascular tone and the secretion of insulin. The purpose of this investigation was to observe the effect that hydrostatic pressure had on intracellular calcium signaling. Tests were also conducted with the enabling of transendothelial water flux, a consequence of hydrostatic pressure. Lung capillary endothelial cells were cultured in Transwell® Permeable Supports, incubated with a calcium-sensitive fluorescent dye solution, and secured in a Ussing Chamber prior to being imaged. Up to 20 cm H₂O of hydrostatic pressure was applied to the cells *in vitro* and images were captured simultaneously with the program AxioVision. To measure the effect of water flux on calcium levels, an outflow tube leading to an empty reservoir was opened during imaging. Definitive results were difficult to determine since only a few confluent monolayers were imaged and it was not clear that there was good loading of the dyes. However, results were obtained that showed that levels of calcium did not increase with the addition of hydrostatic pressure. Water flux through the cells also failed to increase calcium levels. More detailed studies are required to fully understand the relationship between hydrostatic pressure and the regulation of calcium and eNOS.

C03

Quantification of Virus-Like Particles in Mice Fed a Lowfat or High Milkfat Diet

Presenter(s)

Zi-Ning Choo, Illinois Mathematics and Science Academy

Advisor(s)

Eugene Chang, University of Chicago

The gut microbiota, which consists of the microorganisms housed in the mammalian intestine, shifts in response to dietary changes and influences physiological functions such as nutrient absorption and inflammation. The effects of the microbiota may be modulated by the gut virome, which includes bacteriophages that infect intestinal bacteria and can be induced by stress. The aim of this study was to determine whether the quantity of phages in the gut is affected by diet. Specific pathogen-free mice raised on either low-fat (LF) or 18% milk-fat (MF) diets for four weeks were placed on the other diet at the beginning of this study, then returned to their original diets after 21 days. Stool samples collected before and after both diet changes were homogenized and passed through a 0.22 μm filter to remove bacteria. Fractionation by ultracentrifugation using density gradient was then performed to isolate virus-like particles (VLPs). VLPs were subsequently collected on a 0.02 μm filter and quantified using SYBR Gold staining and fluorescence microscopy visualization. While VLP numbers stayed fairly constant in mice initially fed the MF diet, the number of VLPs were higher in LF diet mice and dropped when these mice switched to a MF diet. The difference in VLP numbers between the two groups was statistically significant ($df = 1, 24, F = 11.506, P = 0.002$), suggesting that diet may play a role in determining VLP quantities in the gut.

C04

Detection of A β Oligomers in Alzheimer's Disease Rodent Models via Immunohistochemistry

Presenter(s)

John Deng, Illinois Mathematics and Science Academy

Advisor(s)

Himanshi Desai, Northwestern University

William Klein, Northwestern University

Pascale Lacor, Northwestern University

Alzheimer's disease (AD) is a neurodegenerative disease characterized by deposition of amyloid plaques and tangles. Recently, A β derived oligomers have been proposed as more potent neurotoxins but their detection in the brain is still not optimal. In this study, we use immunohistochemistry protocols and background quenching techniques to increase signal-to-noise ratio for better detection of A β oligomers. Brain tissue from transgenic rodent AD models were treated with PBS, sodium borohydride, or a biotin kit to quench background noise due to endogenous biotin. These slices were then labeled with antibodies directed against different A β species (B6E10 or NU4) detected by fluorescently-tagged secondary antibody or Streptavidin complex conjugated to fluorophore or quantum dots and imaged using a confocal microscope. The results indicate that sodium borohydride significantly quench background noise cause by endogenous biotin. The biotin kit, however, does not have a statistically significant effect in reducing endogenous biotin. Additional quantification of signal strength for using quantum dots is expected to enhance signal strength and reduce background noise. This research offers new insights to better detect A β oligomers in brain tissue and identify their localization in regard to amyloid plaques and will offer the possibility to assess if treatments are efficient at removing A β oligomers.

C05

Mechanisms of Kinesin-Driven Microtubule Sliding

Presenter(s)

Vishrut Dixit, Illinois Mathematics and Science Academy

Advisor(s)

Vladimir Gelfand, Northwestern University

The cellular cytoskeleton comprises a network of microtubules that, together with microtubule motors, is essential for intracellular transport. The microtubule motor kinesin-1 is responsible for the transport of various protein and organelle cargoes. Kinesin contains a motor domain on the N-terminus that moves along microtubules. In addition to cargo movement, kinesin-1 is also known to drive microtubule sliding. For sliding, kinesin must contain two sites that bind microtubules. One site is the motor domain. The goal of this work is to identify the second site that is important for sliding. Two possibilities are the additional C-terminal binding site that was previously identified biochemically and the binding site in the middle of the heavy chain that interacts with microtubules not directly but through microtubule-binding protein ensconsin. To examine sliding functionality in the absence of ensconsin, we created an artificial truncation of kinesin-1 lacking the auto-inhibition domain and tested the effect of ensconsin depletion by RNAi on sliding. These experiments show that sliding does not require microtubule binding through ensconsin. Future plans involve testing the C-terminal site by eliminating charged amino acids that have an affinity for microtubules. The results of this study increase our knowledge about the mechanism behind sliding, which could have future implications in neurodegenerative diseases since sliding is necessary for axon and dendrite formation.

C06

Pathways in Transforming Growth Factor- β -Induced p35 Expression in Fibrosis

Presenter(s)

Jonathan D'Souza, Illinois Mathematics and Science Academy
Mateusz Wojtaszek, Illinois Mathematics and Science Academy

Advisor(s)

Roberta Marangoni, Northwestern University
Jun Wei, Northwestern University

This investigation explored the mechanisms of the p35/transforming growth factor- β (TGF- β) dependent pathway associated with scleroderma, an autoimmune disease which causes overgrowth of connective tissue. Western blots and polymerase chain reaction were employed to analyze mRNA and protein expression. A time course analysis of human foreskin fibroblasts treated with TGF- β showed that TGF- β increases p35 expression. Fibroblasts treated with adenoviruses carrying a constantly-active TGF- β Receptor I, Ad-TBRI^{ca}, expressed high levels of p35 and alpha smooth muscle actin, confirming that constant TGF- β activation causes fibrosis in fibroblasts. Finally, fibroblasts treated with TGF- β and either with SB431542, a mothers against decapentaplegic homolog (SMAD) suppressor, or U0126, an extracellular signal-regulated kinase (ERK) suppressor, revealed that both SMAD and ERK can contribute to elevated levels of p35 expression. However, it is not yet known which one induces a greater gene expression response. These results suggest that the SMAD and ERK pathways mediate the TGF- β -induced increase in p35 expression in connective tissue. Knowing this, future studies can focus on possible pharmaceutical applications, namely the targeting of SMAD and ERK or their downstream effects, in the treatment of scleroderma and fibrosis.

C07

Physical Interactions of Regulatory Sequences Within Schizophrenia Associated MIR137 Locus

Presenter(s)

Kristy Fang, Illinois Mathematics and Science Academy
Nahee Park, Illinois Mathematics and Science Academy

Advisor(s)

Jubao Duan, Northshore Research Center
Catherine Leites, Northshore Research Center

Genetic variants at a non-coding MIR137 locus are found associated with schizophrenia in recent genome-wide association studies. However, whether MIR137 or other nearby genes (for example, DYPD) is affected by the genetic variants is unknown. The objective of this investigation was to examine which genes' promoters interact with the regulator sequences that harbor the putative disease-causal genetic variants. A chromosome conformation capture assay was performed to detect the physical chromatin interaction between different regulatory sequences (for example, gene transcriptional enhancer and a gene promoter) in SH-SY5Y (neuroblastoma) and LCL (B-lymphoblastoid) cells. Cells were fixed to retain the chromatin interaction conformation, cut and religated to enrich physically interacting segments, and finally enhanced and detected using the polymerase chain reaction (PCR) protocol and gel electrophoresis. Strong and specific PCR amplifications for primer pairs in MIR137 enhancer and promoter sequences were detected, but not for primer pairs with MIR137 adjacent regulatory sequences and DYPD promoters. Therefore, regulatory sequences where schizophrenia-associated genetic variants reside most likely regulate expressions of MIR137 but not DYPD. Identifying the physical interaction relationships between regulatory sequences of different regions at the MIR137 locus will help to understand the causal molecular mechanism of the genetic variants associated with schizophrenia.

C08

Gold-Capped Zinc Oxide Nanoparticle Inhibition of Herpes Simplex Virus Type-1 Infection in HeLa Cells

Presenter(s)

Marisol Flores, Illinois Mathematics and Science Academy
Estefany Guzman, Illinois Mathematics and Science Academy

Advisor(s)

Thessicar Antoine, University of Illinois at Chicago
Deepak Shukla, University of Illinois at Chicago

Herpes simplex virus (HSV-1) entry into mammalian cells is facilitated by the attachment of glycoproteins gB and gC to heparan sulfate proteoglycan side chains located on the cellular membrane. The pretreatment of HeLa cells with zinc oxide nanoparticles interferes with the attachment of HSV-1 to heparan sulfate as nanoparticles attract and neutralize virus particles. To evaluate the effect of gold capped zinc oxide nanoparticles on HSV-1 infection in HeLa cells, the gold capped zinc oxide was incubated with cells prior to infection with the HSV-1. Following pretreatment of cells with the gold capped zinc oxide, we performed an ONPG viral entry assay. Cells were infected with an HSV-1 β -galactosidase expressing reporter virus. Results showed that pretreatment with the nanoparticle significantly decreased viral entry. In addition, we performed a virus free cell-to-cell fusion assay to explore the effect of our nanoparticles on cell fusion. Results showed that gold-capped zinc oxide is a strong inhibitor of cell-to-cell fusion, highlighting the inhibitory properties of gold-capped zinc oxide against HSV-1 cell-to-cell spread. In conclusion, the nanoparticles were found to be an effective inhibitor of the virus entry and spread.

C09

The Effect of the Physical Barrier of a Small Tributary on Gene Flow of Three Avian Genera in the Congo River Watershed

Presenter(s)

Ellen Gieser, Illinois Mathematics and Science Academy

Advisor(s)

Shannon Hackett, Field Museum

Barriers to gene flow are regarded as important factors in the evolution of populations and species, especially in tropical regions. Given that large bodies of water often act as a barrier to gene flow, I assessed the role small rivers might have on genetic diversification by restricting movement of individuals across the geographical landscape of a region in Africa. I extracted DNA sequences from blood samples of thirty-six individuals from three avian genera (*Bleda*, *Erithacus*, and *Trichastoma*), sampling the mitochondrial genome of these lineages from both sides of a Congo River tributary. The mitochondrial NADH dehydrogenase subunit 3 gene was amplified using standard polymerase chain reaction techniques and sequenced using an Applied Biosystems 3730 DNA Analyzer. The degree and nature of genetic variation within and among populations and genera suggested no significant evidence for nucleotide differentiation among the three localities or across the river. Genetic variability present among individuals within species in each genera (~1.3%) was typical of within population levels of variability in other birds. Either the tributary was not a significant barrier to gene flow, or not enough time has passed for the effects of the barrier to be reflected in significant genetic differentiation.

C10

Exosome Uptake in Bladder Cancer Cells

Presenter(s)

Shivani Goel, Illinois Mathematics and Science Academy

Advisor(s)

Carrie Franzen, Loyola University

Gopal Gupta, Loyola University

Exosomes are secreted microvesicles that help mediate intercellular signaling pathways through their RNA and protein content. This investigation focused on analyzing exosome uptake by bladder cancer cells. Exosomes were isolated from bladder cancer cells by ultracentrifugation and stained with the membrane dye, PKH-26. They were then incubated with bladder cancer cells for different time periods. The cells were run through the Amnis ImageStream^X, an imaging flow cytometer, which identified PKH-26 internalized exosomes. We measured the number of PKH-26 spots and PKH-26 fluorescence intensity to determine total uptake, which increased with longer incubation times. A lack of effect on uptake after trypsin treatment indicated that exosomes were internalized. This was confirmed by deconvolution microscopy. Storing the exosomes at 4°C or -20°C did not affect exosome uptake, although incubating cells with labeled exosomes at 4°C completely blocked it. We developed a novel method for quantifying exosomes and determined a threshold level and optimal incubation time of exosomes for efficient uptake. There was verification of the internalization of exosomes and the finding that exosome uptake is an active and specific process, as incubation at 4°C blocked uptake. This data will be useful in developing exosomes into a cancer diagnostic or therapy.

C11

Methods of Quantifying Oocytes in P2 CD1 Mice

Presenter(s)

Jimmy Huang, Illinois Mathematics and Science Academy

Yuanhao Wang, Illinois Mathematics and Science Academy

Advisor(s)

Takeshi Kurita, Northwestern University

Vanida Serna, Northwestern University

Female mammals are born with a fixed supply of oocytes, but factors such as disease, age, and chemotherapy decrease the quality of oocytes, reducing fertility; thus there is an urgent need for therapeutic treatments to protect oocyte quality. Mouse models are necessary to develop therapies; however, the entire ovary must be utilized so other analyses cannot be performed. The objective of this investigation was to establish an accurate sampling method for oocyte counting. Ovaries from two-day-old CD1 mice were dissected, fixed, processed into paraffin blocks, and sectioned by a standard histology method. Nuclei of oocytes were labeled by fluorescence staining for DNA and p63 protein and counted. Our original equation included the thickness of tissue sections to determine the number of oocytes; however we were unable to accurately gauge the thickness. Hence, we adapted another model, which involves only measurable parameters such as number of counted oocytes. Our results showed that an ovary in two-day-old CD1 mice contains 5,055,965 oocytes with a standard deviation of $\pm 1,382$. A reasonable method for discovering the number of oocytes per ovary has been identified, however, some problems still exist such as being able to count all of the oocytes seen.

C12

The Effects of Dimethyl Fumarate on Glioma Cells

Presenter(s)

Vandana Karan, Illinois Mathematics and Science Academy

Advisor(s)

David Braun, University of Illinois at Chicago

Douglas Feinstein, University of Illinois at Chicago

Previous studies have found the anti-inflammatory drug dimethyl fumarate (DMF) to show benefits in colon cancer, and research also indicates that DMF could have significant cytotoxic effects on glioma cells. To test the effects of DMF on glioma cells, various dosages of DMF were incubated with the C6 rat glioma cell line along with its nontransformed primary cell counterpart, astrocytes. Lactate dehydrogenase assays were run to measure the amount of released LDH, a marker for cell death, for a given culture after different incubation times. Caspase assays were used to test the possibility that DMF activates caspase proteins to induce apoptosis. We found DMF to be toxic to C6 cells, while protective to primary cells at high dosages. The amount of cell death in C6 cells increased to three times the baseline after treatment with DMF. Astrocyte cell death, in comparison, decreased by about 5%. Results from caspase assays show no relationship between DMF and caspase-mediated apoptosis. Many current treatments for cancer are harmful and toxic to primary cells, often resulting in cell death. The use of DMF in conjunction with current therapies could lower the required dosages of toxic treatments, and result in less death of healthy cells.

C13

Hydrogen Peroxide Production in High Nitric Oxide Adapted Human Cancer Cells Which Express Tumor Stem Cell-Like Properties

Presenter(s)

Kathryn Kim, Illinois Mathematics and Science Academy

Rohan Verma, Illinois Mathematics and Science Academy

Advisor(s)

Kim Elseth, University of Illinois at Chicago

Aqil Madeeha, University of Illinois at Chicago

James Radosевич, University of Illinois at Chicago

Recent studies have shown that tumor cells exposed to increasingly high concentrations of nitric oxide donor DETA-NONOate grow aggressively and have tumor stem cell-like properties. Since tumor stem cells are generally anaerobic, they should have a higher rate of H_2O_2 production. In our study, human adenocarcinoma cell lines from the lung, breast, and oral cavity and the same cell lines adapted to HNO, were tested for H_2O_2 production using the Amplex Red Hydrogen Peroxide Assay. A standard curve was produced using varying concentrations of commercially available H_2O_2 . The results showed that the parent cell line expressed comparably more H_2O_2 contrary to our hypothesis. These data were confirmed using the CellRox Deep Red Reagent which directly measured oxidative stress and showed it to be higher in parent tumor cells as opposed to in HNO cells. Although we hypothesized that the HNO cells would be higher H_2O_2 producers, the parent tumor cells appeared to have upregulated enzymes such as glutathione-S-transferase pi to counteract the free radical upregulation of the HNO cells. These data support previous studies and suggest the importance of free radical protective mechanisms, but further research is needed to confirm the presence of these enzymes.

C14

Analysis of Critical PKC δ Sites on Sarcomeric Protein Phosphorylation and Function

Presenter(s)

Srisha Kotlo, Illinois Mathematics and Science Academy

Advisor(s)

Marcus Henze, University of Illinois at Chicago

John Solaro, University of Illinois at Chicago

Cardiac troponin I (cTnI), an inhibitory subunit of the troponin complex, is a key regulator of cardiac muscle contractility. cTnI is phosphorylated by protein kinase C (PKC) at serine 23/24, serine 43/45, and threonine 144, sites which are crucial in the regulation of cardiac function. PKC δ has a unique C2 domain that is thought to target PKC δ to its substrates, and also has an ATP binding domain that contains the serine 357 phosphorylation site that may regulate PKC δ 's substrate specificity for these specific sites. Here, we analyzed the kinase function and substrate specificity of PKC δ - Δ C2 (C2 domain deleted) and PKC δ -S357A (mutation from serine to alanine) mutants on sarcomeric proteins. Our results show that PKC δ - Δ C2 and PKC δ -S357A have increased autophosphorylation and increase the phosphorylation of TnI and TnT compared to wild type PKC δ . The PKC δ -S357A does not appear to confer a change in substrate specificity. This suggests that increased phosphorylation of TnI by PKC δ - Δ C2, a known splice variant of PKC δ , may be an underlying mechanism for depressed cardiac contractile function. Future experiments will test the functional effect of PKC δ - Δ C2 on cardiac muscle contractility by measuring the force-calcium and ATPase-calcium relationship.

C15

Effects of Gestational Hormones on Free Fatty Acid Receptor 2 Expression During Pregnancy

Presenter(s)

Maria Kuznetsov, Illinois Mathematics and Science Academy

Advisor(s)

Brian Layden, Northwestern University

Free fatty acid receptor 2 (FFAR2) is a G-protein activated receptor activated by short chain fatty acids whose expression levels increase during pregnancy in mouse islets. This increase in expression of FFAR2 is anticipated to be due to elevations in hormone levels. In this study, we have explored the regulation of FFAR2 expression using hormones that are important during pregnancy, dexamethasone, estradiol, progesterone, and prolactin. Mouse islets were incubated with the hormone for 24 hours with each of these hormones at physiological levels. Following incubation, RNA was isolated, and cDNA was synthesized. Data was obtained by using reverse transcriptase polymerase chain reaction to identify changes in expression. Results have shown that exposure to dexamethasone and estradiol decreases expression of FFAR2. However, incubation with progesterone and prolactin increases expression. These data suggest that the expression of FFAR2 may be dynamically regulated during pregnancy in islets by pregnancy-related hormones.

C16

Molecular Cloning and the Presence of *MST1R* in Gastroesophageal Adenocarcinomas

Presenter(s)

Jiwon Kwak, Illinois Mathematics and Science Academy
Nitya Pariti, Illinois Mathematics and Science Academy

Advisor(s)

Daniel Catenacci, University of Chicago

The macrophage stimulating 1 receptor (*MST1R*) gene, also known as the *RON* gene, is an oncogene, a gene that can potentially cause cancer. Since it has been hypothesized that abnormal activation of this gene contributes to cancerous growth in gastroesophageal adenocarcinomas, investigations of possible *MST1R* signaling inhibitors are of interest. We cloned the 4.2 kilobase *MST1R* gene into bacteria, verified by DNA sequencing. To correlate *MST1R* amplification and tumor growth rate, seven cancerous cell lines were peritoneally injected into nude mice. Using fluorescence *in situ* hybridization, it was determined that *MST1R* overexpression led to cancerous growth in mice, and that cell lines not expressing *MST1R* and those that were treated with *MST1R* inhibitors had decreased tumor growth. These studies confirmed that *MST1R* plays a role in oncogenesis, and that targeted inhibition may lead to improved clinical outcomes in patients.

C17

Construction of Pathways Involving Genes Related to Severe Congenital Neutropenia

Presenter(s)

Jennifer Kwon, Illinois Mathematics and Science Academy
Kenneth Yun, Illinois Mathematics and Science Academy

Advisor(s)

Seth Corey, Northwestern University

Severe congenital neutropenia is characterized by the body's low count of neutrophils. Patients diagnosed with this disease are more vulnerable to disease and prone to recurrent infections. This disease is a bone marrow failure syndrome where stem cells are unable to mature from promyelocyte/myelocyte to neutrophils. Cytoscape is a bioinformatics software that allows the analysis of a set of genes and maps out their interactions. First, a search was done for all genes related to severe congenital neutropenia. This created a path for granulopoiesis (the maturing of bone marrow stem cells into mature neutrophils and other white blood cells) that mapped the associated genes. The results showed that the following genes were the main source of the problem: *ELANE*, *HAX1*, *CSF3R*, *WAS*, *G6PC3*, *GFI-1*. For example, *CSF3R* codes for the granulocyte colony-stimulating factor receptor which means that a mutation in the *CSF3R* gene will inhibit cell signaling, specifically cytokine signaling involved in granulopoiesis. Genetic mutations that cause severe congenital neutropenia have revealed the clockworks of monitoring of proliferation and death of granulocytes. Each mutation affects a cell in a unique way and implies the existence of multiple pathways in the development of severe congenital neutropenia.

C18

Morphologically Unique Marine-Derived Bacteria as a Source of Natural Product Discovery

Presenter(s)

Grace Li, Illinois Mathematics and Science Academy

Advisor(s)

Skylar Carlson, University of Illinois at Chicago

Brian Murphy, University of Illinois at Chicago

Mark Sadek, University of Illinois at Chicago

The demand for new antibiotics is growing, and the search is branching out to newer sources, such as the marine environment. In the past, Gram-positive marine-derived bacteria, especially Actinobacteria, have had a higher success rate of new compound discovery than their Gram-negative counterparts. Because of this, in the past, focus has been on actinomycetes rather than other bacteria. This investigation focuses on bacteria that are morphologically unique. Unique refers to non-Actinomycete bacteria that exhibit unique colony morphology when compared with Actinomycetes or the majority of slimy Gram-negative bacteria. For this investigation, bacteria samples were collected from various freshwater and saltwater locations and the ones of interest were isolated. These strains are grown in liquid media and their metabolites extracted. The metabolite extracts were screened against bacterial pathogens (*Mycobacterium tuberculosis*, *Enterococcus faecalis*, and so forth) and drug-resistant ovarian cancer cell line OVCAR5. One of our bacterial strains was found to be active against OVCAR5. Analysis of 16S rDNA will be conducted to identify the genus, and chromatographic techniques will be used to isolate the active compounds. Thus the lesser studied non-Actinomycete marine-derived bacteria may be a potentially rewarding source of bioactive compounds for drug-lead discovery.

C19

The Effect of Xanthone, *Artemisia absinthium* Extract and 6-O-angeloylplenolin on the Apoptosis Rates of Human Epithelial Breast Adenocarcinoma Cells

Presenter(s)

Lily Lou, Illinois Mathematics and Science Academy

Ciara Wardlow, Illinois Mathematics and Science Academy

Advisor(s)

Robyn Fischer, Illinois Mathematics and Science Academy

Glenn "Max" McGee, Illinois Mathematics and Science Academy

It has been shown that apoptosis, or programmed cell death, can be induced in cancer cells with the use of certain organic compounds. For this experiment we chose three compounds, xanthone, *Artemisia absinthium* extract and 6-O-angeloylplenolin, shown to induce apoptosis in other types of cancer cells and planned to identify whether or not they induced apoptosis in MCF-7 (Michigan Cancer Foundation-7) cells. We tested 5, 15, 25, 35 and 45 $\mu\text{g/mL}$ of *Artemisia absinthium* extract; 5, 10, 20, 40 μM for xanthone and 9 μM for 6-O-angeloylplenolin. Cells were exposed for 24 hours to *Artemisia absinthium* extract and for 48 hours to xanthone and 6-O-angeloylplenolin. We ran Western blots to detect the amounts of cleaved Caspase-3, an enzyme abundantly present in apoptotic cells, in the MCF-7 cells after exposure to the compounds. We are currently running Western blots on our samples and awaiting results.

C20

Heat Shock Protein 70 Mediates IL-10 Production Through ERK Phosphorylation

Presenter(s)

Anuj Marathe, Illinois Mathematics and Science Academy

Advisor(s)

Eugene Chang, University of Chicago

Yunwei Wang, University of Chicago

Heat shock protein 70 (Hsp70) is an important chaperone molecule found ubiquitously throughout the body. Recently, it has been shown to guard against inflammatory damage by regulating anti-inflammatory cytokine interleukin 10 (IL-10) production in regulatory T cell (T-reg) populations in the intestine. This study aimed to explore the pathway by which this occurs. Five wildtype (WT) and five Hsp70 knockout (KO) mice were induced with severe bowel inflammation using dextran sodium sulfate. After five days of treatment, mesenteric lymph nodes were collected and used in a Western blot, which showed ERK protein kinase was significantly downregulated in Hsp70 KO mice. This means that Hsp70 regulates ERK phosphorylation which then regulates IL-10 production in T-reg. RAG-1 KO mice were given CD4 CD45RB high T cells (naïve T cells) from WT mice and monitored for five weeks to gauge immune activity and induce intestinal colitis. Then five mice received CD4 CD45RB low T cells (mature T cells) from WT and five mice received CD4 CD45RB low T cells from Hsp70 KO mice. WT cells reversed colitis while Hsp70 KO cells didn't, which once again demonstrates Hsp70's immunoprotective role.

C21

Effect of Ranolazine on Heart Failure Development

Presenter(s)

Shruthi Mothkur, Illinois Mathematics and Science Academy

Advisor(s)

Andrew Wasserstrom, Northwestern University

Over six million individuals live with heart failure in the United States, and that number is on the rise. There are no effective treatments to prevent heart failure but, Ranolazine has been proposed as a pharmacological prevention method. The drug was studied for its effectiveness on early heart failure development. The heart muscle contracts and relaxes in a process called cardiac excitation-contraction coupling that is regulated by Ca²⁺ channels. T-tubule organization is critical to ensure the correct spatial organization of Ca²⁺ entry into the cell so contraction occurs properly. During heart failure, t-tubule organization is disrupted so that Ca²⁺ entry into the myocyte is disorganized causing mechanical problems. Our study measured the t-tubule organization in individual cells and related it to decreased cardiac function during development of heart failure. Rats were fed Ranolazine or Captopril for four months before being sacrificed and analyzed for t-tubule organization. We found that cardiac function decreased with control animals, increased with Captopril, and was left unchanged with Ranolazine. T-tubule organization data is being analyzed to find a correlation with the cardiac function data. The results could help further studies see the effect of Ranolazine in preventing the development of heart failure in humans.

C22

The Role of Multidrug Resistance Proteins in Bile Acid-Stimulated Chloride Secretion

Presenter(s)

Shreya Shanker, Illinois Mathematics and Science Academy

Advisor(s)

Jada Domingue, University of Illinois at Chicago

Mrinalini Rao, University of Illinois at Chicago

Jayashree Sarathy, University of Illinois at Chicago

Bile acids are able to activate chloride secretory pathways, but the amount needed to induce chloride secretion in colonic cell lines is much greater than that needed in primary cultures of colonocytes. The reason for this discrepancy is unknown. Multidrug resistance proteins (MRPs) are known to pump out hydrophobic molecules, some of which could be toxins, from cells. Bile acids at very high concentrations can be toxic to the intestinal epithelium. Therefore we hypothesized that MRPs may be expelling bile acids from human colonic adenocarcinoma (T84) cells, thereby needing a higher concentration of bile acids to induce chloride secretion compared to intact epithelium. To test this hypothesis, T84 cells were probed for the presence of gene transcripts and proteins of MRP isoforms. We found transcripts of MRP2, MRP3, and MRP4 in T84 cells, with MRP4 having the highest mRNA expression. Western blot analysis revealed the presence of MRP4 protein in the membrane fraction of T84 cells. Functional studies looking at the effects of an MRP inhibitor, MK571, on bile acid induced chloride secretion are in progress.

C23

Identifying an Unknown Cyanobacterium by DNA Sequence Analysis

Presenter(s)

Nathan Suek, Illinois Mathematics and Science Academy

Advisor(s)

Piotr Gornicki, University of Chicago

Robert Haselkorn, University of Chicago

A water sample was taken from the lagoon in Washington Park to identify cyanobacteria and to determine their potential toxin-producing capabilities. Cyanobacteria found in the sample were cultured on plates and in liquid using cyanobacterial medium BG11. Genomic DNA isolated from single colonies was sequenced and the resulting reads were assembled into contigs. About two hundred non-overlapping contigs were longer than 10 kb, representing approximately one cyanobacterial genome. No matching sequences were found in databases, indicating that this species' DNA has not yet been sequenced. In order to determine the identity of the cyanobacterium, phylogenetic trees based on 16S and 23S rRNA sequences from one contig were created using MEGA software. We compared our unknown sequence with those identified by BLAST. Our results suggest that the unknown cyanobacterium is closely related to *Pseudanabaena*. We analyzed the longest sequence contig (63 kb) using BLASTX to identify protein-coding genes for further phylogenetic analysis. Several genes have been identified so far. This is the first step towards annotation of the genome and functional mining of the genomic sequence to determine metabolic capabilities of the species such as toxin biosynthesis. Our unknown cyanobacterium is most likely a sub-species of *Pseudanabaena*.

C24**Voluntary Exercise Habits in Spinal Muscular Atrophy Model Mice and the Implications of Exercise in Disease Progression****Presenter(s)**

Hannah Swerbenski, Illinois Mathematics and Science Academy

Advisor(s)

Joey Cardona, Children's Hospital of Chicago Research Center

Christine DiDonato, Children's Hospital of Chicago Research Center

Previous studies have established that physical exercise may be neuroprotective, specifically in the case of spinal muscular atrophy (SMA). Our study seeks to further evaluate the exercise behaviors of SMA mice and the relationship between exercise and SMA disease progression. SMA model mice underwent an eight week voluntary exercise regimen monitored using an electronic running wheel apparatus. Our results show that, compared to a healthy control mouse, SMA mice have a significantly lower average running speed. Additionally, we found that SMA mice spend less time exercising overall, though this difference was not statistically significant. To examine disease progression, we compared exercised and unexercised SMA model mice through a variety of phenotypic assays, including grip strength, hang test, and gait analysis. We also performed morphologic and neurophysiologic analyses to evaluate the effects of exercise on the pathology and function of the motor unit. Across these tests, we found that exercised SMA mice performed equivalent or better than non-exercised SMA mice, however, the positive trend did not reach statistical significance. The results of this pilot study demonstrate a positive relationship between exercise and slowing SMA disease progression that warrants further investigation.

C25**An Analysis of the Components of Azelaic Acid-Induced Systemic Acquired Resistance in *Arabidopsis thaliana*****Presenter(s)**

Arjun Tambe, Illinois Mathematics and Science Academy

Advisor(s)

Nicolas Cecchini, University of Chicago

After an initial pathogen infection, plants often develop a long-lasting and broad-spectrum resistance to new infections at distal sites, called systemic acquired resistance (SAR). Azelaic acid (AZA), a lipidic signal, has been shown to be implicated in the induction of a primed state of SAR in *Arabidopsis*, such that a secondary infection is met with a stronger defense response. Moreover, exogenous AZA treatment induces components such as the *AZII* and *DIR1* genes, which are essential to SAR induction. To better understand AZA-priming signaling components, the effect of exogenous AZA on different *Arabidopsis* SAR-mutant plants was observed. Because AZA also inhibits root growth, the root lengths of mutant and wild type plants in growing media supplemented with and without AZA were compared. The *earli1* and *sfd1* mutants displayed longer principal roots than wild types did, indicating that these genes are important in AZA-induced SAR. The *SFD1* gene seems to be involved in the transport of a mobile, SAR-inducing signal. No relation was found between mutants, AZA, and lateral roots. AZA infiltration *in vivo* did not affect *col-0* gene expression, and the presence of AZA increased *AZII* expression but not *DIR1* expression. Understanding SAR components can provide the possibility of improving plants' chances of surviving pathogenic infections.

C26**Role of Desmoglein 1 in Keratinocyte Morphology and Differentiation During Epithelial Colony Development****Presenter(s)**

Steven Tan, Illinois Mathematics and Science Academy

Advisor(s)

Kathleen Green, Northwestern University
Oxana Nekrasova, Northwestern University

Desmoglein 1 (Dsg1), a protein that makes up desmosomes and plays a role in cell adhesion, localizes in the suprabasal layers of the epidermis in cells such as keratinocytes. My experiment focused on studying the effect of Dsg1 on keratinocyte's differentiation and morphology during epithelial colony development. Keratinocytes with either knockdown (little to no expression) of Dsg1 or overexpressed full length or truncated mutant of Dsg1 in cells silenced for endogenous protein were grown with the EfnA1-Fc peptide to form epithelial colonies. I used two approaches to analyze differentiation and morphology of cell colonies. The localization of actin and Dsg1 were seen in the immunofluorescent imaging to analyze morphology and Western blot was used to analyze levels of protein expression that are markers of differentiation. The results indicated that cell colonies with knockdown of desmoglein 1 had lower levels of differentiation while the overexpression of Dsg1 wild type or truncated mutant recovered differentiation levels. Also, the wild type of Dsg1 recovered actin structure, but the truncated mutant failed to do so suggesting a new role of Dsg1 in keratinocyte morphology. In conclusion, Dsg1 induces higher levels of differentiation and supports proper cell morphology during colony development.

C27**Inducing Apoptosis in HT-29 Colorectal Adenocarcinoma by Use of Metal Ions****Presenter(s)**

Jeremy Tyszkiewicz, Illinois Mathematics and Science Academy

Advisor(s)

Robyn Fischer, Illinois Mathematics and Science Academy
Glenn "Max" McGee, Illinois Mathematics and Science Academy

One of the things that makes cancer dangerous is that it does not go through apoptosis, or programmed cell death, which is when a cell breaks down and dies in a complicated chain of events. It is theorized that metal ions signal the cell to start apoptosis, so using these ions may kill cancer cells and make them less dangerous. An enzyme-linked immunosorbent assay was used to detect apoptosis in the treated cells. Antibodies bind to cleaved caspase 3, a product of apoptosis, and upon addition of other components the solution turns yellow if positive. Testing the absorbency thus shows the amount of cleaved caspase 3, and so the amount of apoptosis undergone by the cells. The metal ions being tested are sodium, potassium, and magnesium at 2.0, 1.5, 1.0, 0.5, and 0.2 M concentrations. The results of the sodium trials suggest that 1.5 and 1.0 M concentrations are the most effective at inducing apoptosis, while the potassium trial suggested a concentration of 2.0M is the most effective. The results of this study may result in cheaper or more effective treatments for cancer.

C28

Estrogen Modulation of Prostate Epithelial Cells

Presenter(s)

Johnny Wu, Illinois Mathematics and Science Academy

Advisor(s)

Wen-Yang Hu, University of Illinois at Chicago

Dan-Ping (Grace) Hu, University of Illinois at Chicago

Gail Prins, University of Illinois at Chicago

Guang-Bin Shi, University of Illinois at Chicago

Estrogen may have a carcinogenic impact on prostate glands through transformation of prostate epithelial cells. Estrogen regulates prostate epithelial cells through three types of estrogen receptors, estrogen receptor alpha ($ER\alpha$), estrogen receptor beta ($ER\beta$), and G protein-coupled receptor. The main goal of this study is to investigate the regulation and role of each estrogen receptor in prostate epithelial cells and their interaction through ligand-independent and ligand-dependent pathways. We began the study by gene knockdown of each individual estrogen receptor through the usage of siRNAs, and then observed the gene expression levels of estrogen receptors by quantitative polymerase chain reaction. We normalized gene expression to housekeeping genes and treated cells with control siRNA that were set to one-fold. Without estrogen, silencing $ER\alpha$ to a mean of around 0.21 significantly increased $ER\beta$ 2.79-folds; in the presence of 10 nM estrogen, silencing of $ER\alpha$ to 29% causes a 2.97-fold increase of $ER\beta$. These results showed that the silencing of $ER\alpha$ by siRNA knockdown upregulates $ER\beta$ expression in prostate epithelial cells both in the absence and in the presence of 10 nM of estrogen. This suggests that in normal conditions, $ER\alpha$ downregulates $ER\beta$ in prostate epithelial cells and that this effect is estrogen independent.

C29

Regulation of Type II Natural Killer T Cell Cytokine Production by Signaling Lymphocytic Activation Molecule-Associated Protein

Presenter(s)

Luke Zhan, Illinois Mathematics and Science Academy

Advisor(s)

Chyung-Ru Wang, Northwestern University
Xiufang Weng, Northwestern University

The project's aim was to explore the signal pathway in interleukin-4 (IL-4) and interferon- γ (IFN- γ) expression by type II natural killer T (NKT) cells in the presence or absence of signaling lymphocytic activation molecule-associated protein (SAP). We used a T cell receptor transgenic mouse model and crossed it onto a SAP deficient background. To investigate the mechanisms that contribute to IL-4 and IFN- γ production by type II NKT cells, we isolated cDNA of type II NKT cells from wild type and SAP deficient backgrounds as templates for real time polymerase chain reaction with primers specific for different signaling pathways of IL-4 and IFN- γ . In particular, we examined the expression levels of transcription factors known to regulate the expression of IL-4 and IFN- γ in T cells, such as GATA-3, JunB, NFAT- α , NFAT- β , IRF-4, and T-bet. After prolonged cell stimulation, both IRF-4 and GATA-3 expression was inhibited in SAP deficient type II NKT cells. NFAT- α , NFAT- β , and T-bet induction did not fluctuate significantly in the presence or absence of SAP. The reported defect in IL-4 expression directly corresponds with the decreased expression of GATA-3 and IRF-4, both of which may function downstream of SAP.

D01

Creating a Metagame in Checkers

Presenter(s)

Martin Bantchev, Illinois Mathematics and Science Academy
Pirapat Kitipongpatana, Illinois Mathematics and Science Academy

Advisor(s)

Donald Porzio, Illinois Mathematics and Science Academy

Checkers has been solved; all possible moves have been mapped out using a computer, due to its simplicity. We removed its perfect balance in order to create a cyclical imbalance metagame which would result in a more interesting and complex game experience. Because we didn't want to change checkers' core mechanics, we created modifications: new pieces that the player could buy at the start using a limited number of points. To test the modifications' effectiveness, we used a twelve player testing group that played our game while supervised. We set up sessions where the players' choice of pieces, moves, and strategies were recorded in move logs and interview sheets. At first, the most prevalent strategy was the Piecafist-King Stall, which used the eponymous pieces' abilities, in combination, to force the opponent into unfavorable positions. This was the only viable strategy, so we had to create a soft-counter to it, the Leapfrog. We witnessed players forming strategies with it to counter the dominant Piecafist-King Stall. We plan on introducing a new piece that is strong against the Leapfrog but vulnerable to the Piecafist-King Stall strategy to create a Rock-Paper-Scissors relationship between strategies, creating what is known as a Big Three metagame.

D02**Testing the Efficiency of the Currency Futures Market****Presenter(s)**

Brennan Wakey, Illinois Mathematics and Science Academy

Advisor(s)

Doug Adams, TransMarket Group

The foreign exchange market is one of the most important financial markets in the world, accounting for trillions of dollars traded daily. If the market were completely efficient, the futures price of a currency could be calculated easily using a formula that relates the current foreign exchange rate and the difference between the foreign and domestic interest rates. Our research tested the efficiency of the foreign exchange futures market by looking at data from past futures contracts. We analyzed this data to see if the prices of the contracts made sense given what we knew about the interest rates. We also examined potential profitable trading opportunities, which we found were often available. Additionally, there were several instances in which the market was very inefficient; the foreign exchange market is not completely efficient. Further research is necessary to better understand the reasons why the market is efficient only in some instances, and it could lead to the development of a reliable trading strategy that would take advantage of the arbitrage opportunities available in the market.

E01**Density Functional Theory Investigation of Silicene and Metal Adatoms****Presenter(s)**

Matthew Deng, Illinois Mathematics and Science Academy
Kent Gang, Illinois Mathematics and Science Academy
Siva Gangavarapu, Illinois Mathematics and Science Academy

Advisor(s)

Ron Hurlbut, Illinois Mathematics and Science Academy
Glenn "Max" McGee, Illinois Mathematics and Science Academy

This investigation aims to study the interactions between adatoms of nickel, iron, and cobalt, and silicene using computational methods. All density functional theory calculations were executed by the program PWSCF as part of the Quantum Espresso software. The study super-positioned adatoms on a silicene lattice layer using coordinate positions, and the results were analyzed using post-processing that provided paramagnetization and charge distributions. Calculations showed that adatoms placed on the center of silicene rings were most stable, due to highest change in absorption energy (eV). The other stable positions were located both above and below the silicon atoms, and the position at the midpoint between those two positions. Furthermore, all reactions between silicene and adatoms were chemically favorable due to the negative value of the change in absorption energy. Compared to iron and cobalt adatoms, the nickel atom reaction with silicene resulted in the highest change in absorption energy. In addition to a stable and energetically favorable reaction between the three adatoms and silicene, the results also suggest that the further away an adatom is from a silicon atom, the more stable the reaction will be.

E02

Hydrodenitrogenation Using Tantalum Single-Site Catalysts

Presenter(s)

Ujwal Kiran, Illinois Mathematics and Science Academy

Advisor(s)

Randall Meyer, University of Illinois at Chicago

As petroleum reserves around the world are depleted, new hydrocarbon sources with increasing amounts of nitrogen will be utilized. Therefore, more efficient methods of hydrotreating these materials must be found to satisfy stringent environmental standards. Our current investigation has focused on the use of a single site tantalum catalyst for hydrodenitrogenation. Using quantum chemical computational methods, this investigation aimed to understand the mechanism of hydrodenitrogenizing 1-tetrahydroquinoline (1-THQ) over a silica supported tantalum catalyst. Research determined that this catalyst operates through a series of reactions. First, 1-THQ above the surface must adsorb to the catalyst through an insertion of the tantalum into a carbon-nitrogen bond. Then, 1-THQ must perform a ring opening reaction via a nitrogen-to-carbon hydrogen transfer. Hydrogenation of this adsorbed complex leads to either formation of propylbenzene or propylamine, which reacts to form propylbenzene. When propylbenzene is formed, NH is left behind on the surface which may be further hydrogenated to form ammonia. The complete potential energy surface for the reaction has been calculated. The results of our investigation show however, that NH₃ formation from NH₂ and H is unfavorable and therefore the catalytic site may be poisoned by the presence of ammonia.

E03

Production of Antibacterial Nanoparticles for Use in Water Filters

Presenter(s)

Jacob Kronenberg, Illinois Mathematics and Science Academy

Advisor(s)

Mark Carlson, Illinois Mathematics and Science Academy

Millions of people in developing nations lack sanitary water. Some filters use silver nanoparticles, an antimicrobial agent. Because cost is pivotal in the developing world, effective nanoparticles from cheaper base metals were sought. The preparations had three components: cationic base metal salt, reducing agent, and chelating agent to limit particle size. Three chelators were tried: citrate, oleic acid, and polyvinylpyrrolidone. In addition to silver nitrate, three metal salts were chosen due to reported antibacterial properties and low human toxicity: copper sulfate, nickel chloride, and zinc nitrate. Ultra-violet (UV) spectroscopy was used to verify the creation of nanoparticles. Measuring growth in liquid cultures of *Escherichia coli* mixed with the nanoparticles quantified killing effectiveness. UV absorbance showed that nanoparticles had formed for all four metals. Silver was most effective at reducing bacterial colony count. Copper and zinc inhibited the enhanced bacterial growth seen with its reactant salt (possibly acting as a nutrient) but not necessarily with respect to the saline control. Nickel was not effective. If the copper or zinc preparations could be made to be as effective as silver in disinfecting water, perhaps by removing unreacted cations, nanoparticle water filters could be cheaper and more available to those who need them.

E04

Understanding and Comparing Photochromic Processes

Presenter(s)

Ryan Leemans, Illinois Mathematics and Science Academy
Travis Scott, Illinois Mathematics and Science Academy

Advisor(s)

Peter Clancy, Illinois Mathematics and Science Academy
Anita White, Illinois Mathematics and Science Academy

This investigation focuses on how the photochromic process works and how to improve it. We tested three different protocols to produce photochromic crystals and compared the results. The first protocol we used was silver nitrate solution in potassium bromide and infused it with titanium sulfate as a stabilizer to yield silver coated photochromic crystals. The second protocol used fine crystals of silver chloride suspended in a solution of tetraethylorthosilicate and sulfuric acid, then infused with silicon dioxide and methylmethacrylate, creating a prepolymer solution that is able to adhere to glass. The final protocol used three silver compounds and infused them with a copper chloride solution to observe if a photochromic reaction occurs. The first trial with silver chloride resulted with darkened samples over a period of an hour but did not return to a clear color when removed from the ultra-violet (UV) light. In the second trial, our silver sulfate similarly turned dark in about thirty minutes but didn't return to clear in the absence of UV light. Our third trial with silver nitrate yielded the same results as the second trial. From our experiments we conclude it is more challenging to create photochromic dyes to turn from dark to clear in the absence of UV light than it is to create them to transform from clear to dark in the presence of UV light. Our experiment, which succeeded in many ways, did fall short of our ambition to improve the process but all together prove to be insightful.

E05

A Thermodynamic and Physical Investigation of the Heusler Alloys Fe_2VAl and Fe_2VSn

Presenter(s)

John McGuire, Illinois Mathematics and Science Academy
Jeffrey Tucker, Illinois Mathematics and Science Academy

Advisor(s)

Philip Nash, Illinois Institute of Technology

This is a study of the physical properties of the compounds Fe_2VSn and Fe_2VAl , both of which are Heusler alloys. Heusler alloys are metal compounds, usually of the form X_2YZ , where X and Y are transition metals and Z is in the groups III-V. They are defined by their crystalline structure and ferromagnetism, which is measured by attraction to common magnets, despite not having any ferromagnetic components. Certain Heusler alloys have been shown useful in advanced medical technology, including that which is used in heart surgery. We investigated the thermodynamic and physical properties of these compounds, including heat of formation specific heat, density, crystalline structure, melting point, and hardness. The thermodynamic properties were measured with calorimeters, which detect minute changes in temperature to measure heat differences in our compounds, both from formation and from melting. The purpose of this study was to contribute to a large collaboration gathering similar data on different compounds. These results show that both compounds are Heusler. Neither compound has any foreseeable industrial or commercial uses, but our collected data has contributed to a worldwide study.

E06

Fabrication of Semiconductor Nanostructures by Metal-Assisted Chemical Etching

Presenter(s)

Daniel Rosenthal, Illinois Mathematics and Science Academy

Advisor(s)

Ralu Divan, Argonne National Laboratory

Leonidas Ocola, Argonne National Laboratory

The efficient formation of silicon organized nanostructures is highly desired due to the potential applications in fields ranging from solar energy conversion to chemical and biological sensing. The goal of this project is fabricating silicon micro and nanostructure by metal-assisted chemical etching. The silicon micro and nanostructures fabrication involves two important steps: patterning the metal layer by optical, interference and e-beam lithography and silicon etching with a solution containing HF and H₂O₂. The Silicon nanostructures are initially patterned by e-beam lithography. It was observed during etching that the patterning metals, gold and platinum, had the tendency to delaminate from the silicon. We found that a very thin layer of 1.5 nm titanium as an adhesion layer for noble metals prevents the metal from detaching from the silicon and greatly improves the accuracy of the patterns etched. After etching, the metal can be used as a base plate for electroplating, having formed silicon nanostructures as a mold. Improved accuracy of etching and thus electroplating allows the fabrication of sophisticated devices, such as highly accurate Fresnel zone plates, diffractive lenses for focusing X-rays for microanalysis, microspectroscopy, and microdiffraction.

E07

The Effects of Cost on Metal-Organic Framework Efficiency

Presenter(s)

Justin Sass, Illinois Mathematics and Science Academy
Yifu Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Randall Snurr, Northwestern University
Emmanouil Tyllianakis, Northwestern University

Scientists are looking to replace fossil fuels with other sources of energy like hydrogen. Storing Hydrogen is the bottleneck for this application, and metal organic frameworks (MOFs) are materials that can offer a solution to this direction. MOFs, can store not only hydrogen but also other light gases of environmental interest. This investigation intended to find a correlation between the cost of the materials used to synthesize MOFs and their performance efficiency, hoping to minimize cost while maximizing efficiency. Scholarly articles were used to find MOF syntheses. MOF costs were obtained by searching up each compound on EM Science or Sigma Aldrich. An excel spreadsheet that includes the names of the MOFs, the articles they are mentioned in, and the prices excel spreadsheet that includes the name MOFs, articles they are mentioned in, and prices per gram was made to record the data. Calculations were performed using the force field, charge, and type of atom on each MOF to obtain the performance of these materials to store light gases like methane at 298°K. The MOFs' surface area and free volume were calculated using the material framework coordinates taken from Cambridge Crystallographic Data Centre and Materials Studio. The resulting spreadsheet, correlates synthesis cost of these materials with their properties and storage capacities. This investigation is a step towards finding materials for environmental applications like replacing fossil fuels with a better alternative.

E08**A Novel Method for Drug Delivery Using Toroidal-Spiral Particles: A Potential Treatment for Cancer****Presenter(s)**

Navika Shukla, Illinois Mathematics and Science Academy

Advisor(s)

Ying Liu, University of Illinois at Chicago

Vishal Sharma, University of Illinois at Chicago

Current methods of brain tumor treatment require the use of synthetic implants, which are only capable of carrying one type of treatment, either an anti-angiogenesis factor or a neoplastic agent. Our novel toroidal-spiral particle aims to provide a synergistic environment in which the effects of both the anti-angiogenesis factor, vascular endothelial growth factor receptor-2 (VEGFR-2), and the neoplastic agent, camptothecin-11, can be combined within a polymer (polyethylene glycol) for a more effective cancer treatment. The novelty of our particle resides in its toroidal-spiral shape, which allows the VEGFR-2 and camptothecin-11 to reside in the open channels within the particle, and therefore prevents destruction of the proteins as is usually the case when polymers are used to encapsulate the drugs. The encapsulation occurs in two phases, the bulk phase and drop phase. The polymeric particle is then cross-linked with a photo-initiator and ultra-violet light. Thus far, we have determined that the particle is capable of sustained, targeted release of the anti-angiogenesis factor and neoplastic agent within cell culture. The next steps would involve determining the effects of the toroidal-spiral particle within various other models, including animal models.

E09**Synthesizing a Library of Combinatorial Catalysts on Surfaces****Presenter(s)**

Aaron Yu, Illinois Mathematics and Science Academy

Advisor(s)

Guoliang Liu, Northwestern University

Chad Mirkin, Northwestern University

Sarah Petrosko, Northwestern University

Combinatorial catalysis is a powerful approach to discover and screen chemical compounds and materials with novel and/or enhanced catalytic properties. Existing methods such as bulk synthesis and thin film deposition are limited either in their throughput or the materials gap between the model catalysts and the ones used in practical application. Therefore, we have to develop a novel process which has a high throughput and can bridge the materials gap in current process. Previously, we have shown that dip-pen nanolithography (DPN) can be used to pattern various single-element nanoparticles on silicon nitride membrane, including noble metals (gold, silver, platinum, palladium) and three-dimensional transitional metals oxides (Fe_2O_3 , Co_2O_3 , NiO , CuO). Our research here focuses on growth of bimetallic nanoparticles from individual patterned seed nanoparticles, for instance, growth platinum on gold. We show that the following parameters, the consistency of particle patterned using DPN, the particle growth time, and the solution concentration, are critical in creating core-shell nanoparticles with high quality. We find that longer growth time and higher solution concentration result in more deposited materials. The synthesis method that we have developed here can be potentially extended to other bimetallic nanoparticles, and used for combinatorial catalysis.

F01**Analyzing and Testing the Monte Carlo Algorithm in the Game of Go****Presenter(s)**

Advitheey Chelikani, Illinois Mathematics and Science Academy

Advisor(s)

Phadmakar Patankar, Illinois Mathematics and Science Academy

The game of Go is one of the only competitively played board games to not have a computer player that can consistently defeat professional level players. The reason for this lies in the vast possibility of moves that can be played each turn. The characteristics of the game of Go were used in order to implement and analyze the Monte Carlo Go algorithm. The Monte Carlo algorithm was chosen because it does not require specific input and because it generates generally strategic moves. Open source computer Go programs were examined, slightly modified, and then tested against each other through Gomill, a Python library. The Monte Carlo algorithm applied to Go involves playing out random moves from a certain position. The move which results in the most optimal future result for the player is chosen and the algorithm is then repeated each turn. In addition to scrutinizing algorithms, a Python library containing Go game rules is being developed in order to aid future programmers. On a large scale, this outcome indicates that the machine may come out on top in the ongoing face off between man and machine.

F02**Integrating and Simplifying Access to IMSA Information Technology Resources****Presenter(s)**

Ryan Eberhardt, Illinois Mathematics and Science Academy

Milosz Kowal, Illinois Mathematics and Science Academy

Advisor(s)

Ralph Flickinger, Illinois Mathematics and Science Academy

Steven Terrell, Illinois Mathematics and Science Academy

Fred Yankowski, Illinois Mathematics and Science Academy

The current access to Illinois Mathematics and Science Academy's (IMSA) information technology (IT) resources is fragmented across many platforms and services, making students' work inefficient and time-consuming. Our investigation focuses on addressing these issues through the development of a single multi-platform user interface aided by campus-wide surveys and beta testing. An initial questionnaire was sent out to the student body, asking students to gauge their current satisfaction with IMSA's IT services. Questions assessed the satisfaction, frequency and purpose of usage of a particular service. For example, questions regarding the user-friendliness of the print server were asked, as well as questions assessing whether or not students utilize the community directory. The responses, combined with feedback received during a private beta testing stage, where a randomly selected group of students was asked to examine a series of wireframes, guided the development of the software. Preliminary results show that students are dissatisfied with the current condition of the information technology environment and that the developed software will increase the students' productivity and efficiency when utilizing the IMSA IT resources.

F03**Developing a Commercial Android Application for a Nonprofit Organization****Presenter(s)**

Amanda Gao, Illinois Mathematics and Science Academy
Kristen Mancini, Illinois Mathematics and Science Academy

Advisor(s)

Debbi Daniel-Wayman, Ten Thousand Villages
John Hayward, Wheaton College
Alissa Maas, Wheaton College

In recent years, the popularity of smartphones has rapidly grown and Android has emerged as a forerunner in application development. Ten Thousand Villages, a non-profit fair trade organization, and other businesses can use smartphone applications to allow their products to reach a wider audience. This investigation focused on developing an Android application after we became proficient in the Java language. Our learning focused on the use of three interfaces: Java code, Extensible Markup Language, and the graphical user interface. Our application was developed using Eclipse software and was tested on various Android devices including the T-Mobile HTC G2 and the Asus Transformer TF-101 Tablet. We created a working prototype which retrieves information from an online database via JavaScript Object Notation and stores it in the Android SQLite database. It begins with a splash screen which opens to a list of items. Each item can be selected to reveal detailed information and a larger image. We learned to make our code structured more efficiently through refactoring. We hope to implement filtering by category and allow automatic updates of the database for offline use. Our ultimate goal is to create an application that Ten Thousand Villages can implement.

F04**Testing the Muon g-2 Experiment Simulation****Presenter(s)**

Jackson Gibbons, Illinois Mathematics and Science Academy

Advisor(s)

Adam Lyon, Fermi National Accelerator Laboratory

The Muon g-2 experiment at Fermilab, before it will be performed, must first be tested with a simulation to ensure success. This simulation, which is still in development, must be tested in turn to ensure that new developments have not made unintentional changes to established functionality. To accomplish this, I coded unit and framework tests in C that run automatically within the Art framework. The unit tests assess individual pieces of code, while the framework tests guarantee that the pieces of code work together properly. Next, I coded framework configuration files, which configure the code and specify parameter input and data and result output. Whenever the simulation code is built, it will be tested automatically, to ensure that no changes to the code have compromised its functionality. This work will help the Muon g-2 experiment prepare to run smoothly when data-taking begins in two years.

F05**Viability of Speech Recognition for Online Student Assessments****Presenter(s)**

Saurabh Kumar, Illinois Mathematics and Science Academy

Advisor(s)

Joseph Dvorak, American Institutes for Research

Online standardized testing is becoming widely incorporated into American schools. The purpose of this investigation is to assess whether speech recognition is viable for students who cannot use a mouse and keyboard. Windows Speech Recognition and Dragon Naturally Speaking Premium and Professional products were evaluated via dictation accuracy testing and analyses of difficulty levels when applied to different test items. After necessary training, Dictation accuracy for Windows was 78 percent, whereas Dragon's accuracy was 96 percent. Furthermore, while MouseGrid and Show Numbers of Windows Speech Recognition provided overall navigation accessibility, Dragon Naturally Speaking's mouse movement and macro creation capabilities simplified navigation strategies and provided easier manipulation of simulation, drag and drop, and hot text items. However, natural language and rich text items affected the psychometrics of the test for all recognizers tested. New speech-related simplifications were then developed to reduce complications, such as command memorization or excessive mouse movement apparent in existing mechanisms. The grid test item is currently undergoing an implementation of these novel designs via modification of the JavaScript interface. Application of the prototype to the test environment and its implications, such as the cocktail party effect, training required, and location of the speech engine necessitate further consideration.

F06**Reusing Bandwidth to Maximize Speed and Coverage for the Growing Demand of Cellular Customers****Presenter(s)**

Mack Lee, Illinois Mathematics and Science Academy

Advisor(s)

Randall Berry, Northwestern University

Vijay Subramanian, Northwestern University

The rapid advancement in cellular technology has caused an increase in demand for cellular data services. The optimization of signal strength relative to interference using frequency reuse is crucial to meet this demand. Frequency reuse is the idea of reusing bandwidth by non-adjacent transmitters. To investigate systems that would achieve desired results, a functional simulation is necessary. Using MATLAB, we were able to successfully create a simulation that models a modern cellular network in which nodes were randomly deployed. Throughout this investigation, we implemented a variety of parameters into our simulation such as noise, interference, density of users, and so forth. With this, we generated a variety of plots ranging from distribution of signal-to-interference-and-noise-ratio to three-dimensional plots of rate outage versus power and bandwidth. From observing these plots and comparing them with analytic curves (for validity), full reuse, using one channel within a system, is far superior to fractional reuse, using multiple channels within a system, and delivers optimal results. Thus, by reusing frequencies, we can maximize the performance of users in a region, as well as the efficiency in bandwidth allocation.

F07**Vehicle Automation During an Earthquake****Presenter(s)**

Arthur Li, Illinois Mathematics and Science Academy

Advisor(s)

Namrata Pandya, Illinois Mathematics and Science Academy

Autonomous vehicles represent a promising innovation for society. These vehicles can help people get around more efficiently and could even save lives during earthquake situations. A robotic vehicle was constructed with a VEX Robotics Design System kit and programmed with ROBOTC. Two challenge scenarios were devised to assess the performance of the vehicle and its optimal responses. The first scenario was dodging falling buildings; the second was navigating through obstacles. The success rate of dodging a falling building, at an optimal event trigger distance, was 65% over forty attempts. Obstacle navigation time difference between automated and optimal manual trials was negligible. These results can provide data for vehicle companies to implement automatic functions during earthquakes into vehicles. These vehicles can optimize people's chance of survival during an earthquake.

F08**Creating a Novel Back-End Database for the Open Tree of Life Project****Presenter(s)**

Jingfei Li

Hyun Bin Park, Illinois Mathematics and Science Academy

Advisor(s)

Richard Ree, Field Museum

The Open Tree of Life project has the goal of creating a collaborative tool for use in compiling various phylogenetic trees for all species. The back-end of the database currently uses a relational database. A graph database, which stores nodes and multiple relationships between nodes as opposed to linear connections, is preferred to a relational database due to simplicity and speed. In this investigation, we created a set of working programs that successfully reads Newick string (a systematic text format for evolutionary trees), and stores nodes and relationships to a graph database. The program then determines certain characteristics of the tree, prioritizes the important information within the tree, and outputs code to render a scalable vector graphic. The new code that uses the graph database allows for less storage space and faster access times, resulting in a resource-efficient back-end for the project.

F09**Improving the Clinical Trials Process Through Efficient Collection and Storage of Protocol Elements****Presenter(s)**

Pratyush Rustagi, Illinois Mathematics and Science Academy

Advisor(s)

Samuel Volchenbom, University of Chicago

The development of industry-sponsored, consortium-driven, or investigator-initiated clinical trials is hampered by an inefficient, antiquated, paper-driven, error-prone system. A more efficient, electronic method of data storage for clinical trial elements will drive downstream processes. A granular understanding of the current processes required for clinical trial approval by the Institutional Review Board at the University of Chicago is required. The process has many steps and includes many people working in different groups. Interaction between and among these groups is required to connect the elements needed to simplify the clinical trial approval process. Through conversations with the Office of Clinical Research, we have identified many redundancies and inefficiencies. In response, we will be developing a semi-automated system that eliminates a substantial amount of human involvement, thus reducing the time required to complete trial approval. Still in progress, this project involves research beyond the school year for adequate completion. The current project is focused on finishing, collecting, and mapping the entire clinical trial approval process at the University of Chicago. Pending successful completion of the first step, there may be opportunities for student involvement in the implementation of a pilot system that corrects a subset of these inefficiencies.

F10**Gathering Open Source Intelligence for Criminal Investigations****Presenter(s)**

Andrew Schell, Illinois Mathematics and Science Academy

Advisor(s)

James Bondi, Illinois Mathematics and Science Academy
Brad Carnduff, Illinois State Police

Open source intelligence, or OSINT, is comprised of data obtained through any sources legally available to the public. Today, OSINT is not widely used in criminal investigations, and this investigation determined how OSINT could be used by law enforcement in order to advance an investigation by providing information unavailable through traditional methods of investigating. To do this, the investigators researched techniques such as searching, viewing data from images, GPS tracking, and cross-referencing numerous sources to find and analyze information on social media, images, and videos, search engines, blogs, and websites. The criteria for determining viable sources of OSINT were the amount of information discovered, how easy the source was to use, and if the data could assist an investigation. What the researchers determined was that the best way to contribute to a criminal investigation was through multiple different sources and using a variety of techniques. The sources and techniques analyzed throughout this investigation are easy to use, making them perfect for introductory level law enforcement officers. The next step is to create a video for law enforcement officers that do not specialize in technology. This video will detail different scenarios where OSINT can be used in order to aid a criminal investigation.

F11**An Algorithmic Implementation of the Bollinger Band Approximation****Presenter(s)**

Michael Zeng, Illinois Mathematics and Science Academy

Advisor(s)

Doug Adams, TransMarket Group

Sergiy Mesropyan, Aardvark Trading LLC

Dennis Wang, Aardvark Trading LLC

Algorithmic trading has been an integral aspect of investing since the early 1970s when it was introduced to the New York Stock Exchange. As a technical analysis tool created by John Bollinger, the Bollinger Bands provide a relative approximation of the highness and lowness of a stock price using standard deviation and moving averages. My investigation created and implemented a method to algorithmically analyze and execute trades based on the Bollinger Band approximation. Using C, the programming standard of the trading world, I built off a sample program provided by the Interactive Brokers application programming interface. This program projected the Bollinger Band approximation onto real market data, by subscribing to market data functions provided by the Interactive Brokers server. When the price of a stock hit either one standard deviation above the moving average or one standard deviation below the moving average, the program would request a trade at those prices and sell when the price hit the moving average. This investigation has implications in being able to not only model stock prices, but, if this pattern holds, this elegant, pattern-recognizing algorithm can help us better understand the world in which we live.

G01**The Congressional Budget Office and Their Accuracy in Deficit Prediction****Presenter(s)**

Samuel Krause, Illinois Mathematics and Science Academy

Advisor(s)

Eric Smith, Illinois Mathematics and Science Academy

The Congressional Budget Office (CBO) was created to be a department of government that would provide non-partisan economic analysis about bills proposed to Congress, providing an alternate economic perspective on proposed bills. Another main task the CBO has is to periodically release documents that show the state of the economy as well as make forecasts as to what will happen if current economic trends continue. My research has been focused around examining the accuracy of the CBO in deficit prediction by finding predicted value for the deficit and comparing that value to what the real deficit was that year. This research has shown that the Executive Branch has been more accurate than the CBO (.0025%) in predicting the deficit over the course of twenty-four years. Although unexpected, this is most likely due to a tendency of the Administration to make optimistic forecasts and the CBO to make pessimistic ones. The slight difference in actual forecasted deficits results from the tendency of the Administration to forecast a lower unemployment rate than the CBO.

G02

Machine Learning Algorithms for Bidding in Auctions

Presenter(s)

Andrew Kuznetsov, Illinois Mathematics and Science Academy

Advisor(s)

Jason Hartline, Northwestern University

Online auctions are applied in such diverse markets such as Federal Communication Commission spectrum, sponsored search, and consumer products. Similar to human bidders on websites such as Ebay, machine learning algorithms are capable of dynamically learning information about bidding situations by analyzing adversary bids from past auctions. This investigation developed algorithms for learning how to bid and evaluated them in bidding simulations. The amount of information available to the machine learning algorithm impacts its ability to learn well. Two models were considered: in the first, bids of all bidders are reported and in the second, only the identity of the winner is reported. The learning algorithms were evaluated in two strategic scenarios. In the first scenario, the algorithms were learning to bid in a first price auction where the opponent bids were selected from a static distribution. In the second scenario, the machine learning algorithm was evaluated bidding against itself in a simulated first-price auction. Preliminary analyses show that the learning algorithm was able to consistently approximate within five percent of the theoretically calculated optimal bid strategy within twenty auctions under the complete information static distribution scenario. Future work in this project includes comparing the performance of human bidders to the algorithm.

G03

National Oil Companies

Presenter(s)

Christine Liu, Illinois Mathematics and Science Academy
Ashley Radee, Illinois Mathematics and Science Academy
Heidi Warning, Illinois Mathematics and Science Academy

Advisor(s)

Lee Eysturid, Illinois Mathematics and Science Academy

National oil companies (NOCs) are responsible for the majority of the oil production in the world. These state owned enterprises, operated either directly or indirectly by the government, are often the largest contributor to their country's economy. However, these companies have inherent structural defects relating to their level of corruption, efficiency, and sustainability. NOCs are effective means for states to control resource wealth but are ineffective in promoting innovation and efficiency. Looking at different examples of companies and their motivations and behaviors, it was determined that national oil companies are economically inefficient from a shareholder's perspective. In states with NOCs, the political motivations of a government are inseparable from their business administrations. While NOCs act as powerful state tools, they include drawbacks that make it impossible to maintain a competitive atmosphere for innovation and globalization. However, when reevaluated from a stakeholder perspective, the role of NOCs as both provider and protector of their countries' best interest becomes apparent.

G04**How Does the Ineffectiveness of Greek Government Contribute to the European Crisis?****Presenter(s)**

Phuong Vo, Illinois Mathematics and Science Academy

Advisor(s)

Christian Nokkentved, Illinois Mathematics and Science Academy

Trouble in the US, beginning in 2007, affected the global economy. One of the issues that emerged was the Euro Crisis, which affected Greece the most. In 2009, Greece was revealed to have been misrepresenting its financial status, especially in the field of banking. My investigation includes the use of popular media along with scholarly sources. In addition, my advisor serves as a crucial component in my understanding of this predicament. I have hypothesized that the corruption in the Greek government caused their country to become the most unstable within the Euro Zone. Under the leadership of Germany, the Euro Zone countries have helped Greece by lending it additional funds as well as forgiving some of its debt. However, Greece's government has neither the resources nor the integrity to improve its economy's current condition. In order to rebuild the nation, political and economic structures will require change. The present situation in Greece could serve as a warning to other countries that have a corrupt government, for results of economic weakness may be catastrophic. The larger lesson to be learned is that the Euro Zone needs to strengthen its ability to respond to crises, and better improve its fiscal policy.

H01**How to Change the World: Redefining Effective Assessment Practices of Twenty-First Century Skills in Specialized Domestic and International Secondary Schools****Presenter(s)**

Ashima Gupta, Illinois Mathematics and Science Academy

Advisor(s)

Glenn "Max" McGee, Illinois Mathematics and Science Academy

As educators rush to adopt the Common Core student learning standards which focus on curriculum content, business leaders and innovators advocate for students to learn twenty-first century skills including leadership, collaboration, creativity, critical thinking, and communication. To assess the extent to which these skills are taught and assessed in the United States and international schools, I have reviewed curriculum documents, published goals, and, when available, tests and instructional practices. This review along with results from a survey of high school teachers regarding the quality and necessity of twenty-first century skills has shown that, although lip service is given to the importance of twenty-first century skills and that teachers express a desire to teach them, there is little evidence in most schools that they are present in the curriculum, taught in classes, or assessed in any formal, systemic manner. Through this research I have developed a set of recommendations for schools that will enable them to incorporate twenty-first century skills into curriculum, instruction, and assessment along with recommended resources for this endeavor.

H02

The Effect of Religiosity Upon the Enacted Curricula of Illinois High Schools

Presenter(s)

Anton Karpovich, Illinois Mathematics and Science Academy

Advisor(s)

Deborah Scarano, Illinois Mathematics and Science Academy

The battle over the teaching of evolution in classrooms is not new; it began with the Scopes Monkey Trial. And recently, America's Political Right is weighing proposals that question the science of evolution. Despite the controversy, a review of the literature found that few studies had analyzed the influence that a community's religion had on the science curricula enacted in its high schools. This study used data on the religious makeup of each county in Illinois, and the Survey of Enacted Curriculum data containing detailed breakdowns of science subjects taught in Illinois schools, and their correlation to national standards and test scores. The data from these sources was analyzed with a multiple regression to determine how much of the variance in the science curricula could be explained by variation in religiosity. Although most variables were not influenced by religiosity, highly evangelical counties had lower emphasis on communicating understanding ($R^2=0.130$, $p=0.026$), with the same counties also having marginally significant trends toward higher PISA scores ($R^2=0.084$, $p=0.061$). Parochial schools did not have significantly different curricula than public schools ($T=1.013$, $p=0.311$). This study found that the religious makeup of a community did not have a large effect on science curricula.

I01

An Exploration Into Altitude and Ascent Rate Control System Design in High Altitude Balloons

Presenter(s)

Michael Adams, Illinois Mathematics and Science Academy

Daniel Francis, Illinois Mathematics and Science Academy

Jennifer Hoelzer, Illinois Mathematics and Science Academy

Advisor(s)

Geza Gyuk, Adler Planetarium

Ken Walczak, Adler Planetarium

When compared to orbiting satellites, high altitude balloons are an effective option for gathering meteorological and astronomical data, and cost much less. In order to further increase their effectiveness, this investigation explored design options for a system that would control altitude and ascent rate in High altitude balloons. After time spent on background research, we decided to use a computer-controlled ballast release system. Several different designs were constructed and tested both in the lab and in stratospheric flight. Challenges included optimizing volume to surface area ratio, ballast determination, design of release mechanism, and software design. The design characteristics found most effective were a ball valve controlled by an Arduino and stepper motor attached to a square prismatic ballast tank. Through multiple tests this design shows potential and is an indicator that further ascent rate control is possible. If we were to continue our research further, we would refine our methods that have proven effective in the lab to create a working system for ascent control.

I02

Advancing Communication for the Disabled

Presenter(s)

Kendell Byrd, Illinois Mathematics and Science Academy

Advisor(s)

James Gerry, Illinois Mathematics and Science Academy

Each year approximately 5,600 people are diagnosed with amyotrophic lateral sclerosis (ALS), a neurodegenerative disorder that makes it progressively harder for people to communicate and function. Inspired by the efforts of people afflicted with ALS to lead a normal life, this year my investigation focused on the following question: "What device(s) can I create that will allow the disabled, specifically those who lack the usage of their voice box and arms, to communicate effectively." This investigation is researching the possibility of constructing a brain-computer interface device that utilizes electroencephalography (EEG) technology to utilize the brain as a control device. Additionally, this project is focused on working with existing EEG devices and focused on the prospects of designing an inexpensive eye gaze control device. By combining these two devices and developing an integrated software system, this device would allow a person to efficiently select letters and make words using their brain and eyes. Ultimately, by using computer speakers and standard text to speech capabilities, the user will be able to actually speak to people despite their disability, improving communication for the world.

I03

Evolving the Touch Pad to Create New Environments

Presenter(s)

Brian Chien, Illinois Mathematics and Science Academy

Advisor(s)

J. Edward Colgate, Northwestern University

Smart technology is constantly evolving to improve interaction between humans and mechatronic devices. While touch and sight were effective in the early years, a revolutionary new field known as haptics responds to the human touch. Currently, the Laboratory of Intelligent Mechanical Systems at Northwestern University is devising a way to utilize human touch by altering the levels of friction on the touch pad as the finger slides across on the Kindle Fire TPaD. To do this, a modified touchpad with piezoelectric actuators is attached to the hardware. Then, the Android coding involved utilizes the modifications to send a frictional response after receiving a physical input. One application that utilizes the TPaD is a dynamic slider, where a general piecewise function calculating amplitude from the slider value, number of indents, and indent width is used to determine the level of friction on the TPaD as the finger is at a certain position on the slider. The program is currently being modified so that the friction can be measured in a sinusoidal function or sent from a physical input anywhere on the screen. In the future, these functions may be frictional changes to regular Android applications for commercial use and development.

I04**Decreasing Noise Produced by Wind Turbine Blades While Preserving Efficiency****Presenter(s)**

Evan Derse, Illinois Mathematics and Science Academy

Advisor(s)

Branson Lawrence, Illinois Mathematics and Science Academy

Glenn "Max" McGee, Illinois Mathematics and Science Academy

The investigation was begun collaboratively with students in China to work towards developing wind turbines. The investigation concerns reducing noise produced by wind turbines, as this can be a major annoyance and a potential limiting factor in the placement of wind turbines. Wind turbines and turbulence patterns were researched before designs were developed in Autodesk Inventor computer-aided design software. These designs were printed using a three-dimensional printer. Additionally computational fluid dynamics (CFD) tests were run using Autodesk Simulation CFD to analyze turbulence patterns generated by the turbines. The main structure being tested that modifies traditional wind turbine design is a flared turbine blade tip to break up the swirling turbulence patterns formed by the blade tip's motion. The investigation began testing in China, where three turbines were tested for efficiency and found that the experimental blade generated more energy than the control. However, there were some questions as to the accuracy of the tests. More preliminary testing was conducted on two of the turbines, but no meaningful data resulted due to errors in testing methods. The investigation will continue to improve its testing methods and work toward gathering meaningful data from which conclusions can be drawn.

I05**Investigating and Evaluating Roller Coaster Propulsion and Energetics****Presenter(s)**

Claire Hensley, Illinois Mathematics and Science Academy

Advisor(s)

Peter Clancy, Illinois Mathematics and Science Academy

Many roller coaster enthusiasts are familiar with the concept that the first hill on a roller coaster is always the tallest because of the frictional loss of mechanical energy. Traditional chain lift motors are slow and spatially demanding, but the introduction of alternative methods of propulsion would rectify these and other impracticalities. Initially, we focused on investigating and evaluating different propulsion methods for the optimal ride. We first consulted literature on the subject and took a tour of Six Flags Great America with one of their electrical engineers. In order to evaluate chain lifts and investigate the energetics of roller coasters, a K'NEX model roller coaster was constructed. We measured height at regular intervals along the track and that data was used to predict velocities at each interval. Actual velocity measurements allowed us to quantify the frictional loss of kinetic energy. A model linear induction motor was also constructed and we performed measurements to determine efficiency and energy output. The data from these two models will be used in the final propulsion method evaluation and explanation.

I06**The Design and Development of a Stair Climbing Robot****Presenter(s)**

Valerie Moore, Illinois Mathematics and Science Academy

Advisor(s)

James Gerry, Illinois Mathematics and Science Academy

Robots can move horizontally without much difficulty, but they cannot yet move vertically with ease. The goal of the project is to design and build a robot that can climb stairs, the most common form of vertical movement used by humans. Beginning with brainstorming, a basic idea of the robot was formed. Computer-aided design (CAD) software, Autodesk Inventor 2013, was used to create a three-dimensional virtual model of the robot. The three-dimensional CAD program was used to create part files that were cut out using the computer numerical control machine. A three-dimensional printer was used to print out wheels for the robot. A programmed arduino runs four servos that drive the robot. Due to cost constraints and the availability of parts, a 4:1 scaled model was constructed. A scale model of the stairs was constructed for testing. The next steps in this process would include building a full scale robot and making the bed stay level while the robot climbs the stairs.

I07**Design and Analysis of a Low Speed Solar Vehicle That Effectively Functions in a Rural or Suburban Environment****Presenter(s)**

Sreyesh Satpathy, Illinois Mathematics and Science Academy

Advisor(s)

Dayal Parthi, National Institute of Technology

This investigation aimed to develop a low-cost, low speed solar vehicle. This vehicle was developed to be effective in Rourkela, Orissa, India, a suburban area which has electricity for most of the day, but suffers from power outages due to a lack of infrastructure and a relatively weak grid. The team tested different methods of increasing the efficiency of the vehicle while focusing on a design that could be implemented at a low financial cost of about \$8000, to be able to run at speeds below 40 km/h, and to be able to take people around with lightweight baggage. Then a survey was performed to analyze the strengths and weaknesses of the vehicle, and possible changes that should be made to future applications. The final product was deemed a success by the team and the people surveyed.

I08**A Novel Design for Measuring Field Programmable Gate Array Radiation Tolerance****Presenter(s)**

Stephanie Wang, Illinois Mathematics and Science Academy

Advisor(s)

Jinyuan Wu, Fermi National Accelerator Laboratory

A field programmable gate array (FPGA) is an integrated circuit, designed to be configured by users after manufacturing, hence field programmable. The ability to update the functionality after shipping enables FPGAs to be used in a growing range of applications, such as digital signal processing, medical imaging, computer vision, speech recognition, bioinformatics, and metal detection. The use of FPGAs also plays an integral part in the Mu2e project at Fermi National Acceleration Laboratory. Several FPGA chips were irradiated in a nuclear reactor in University of California at Davis with radiation dosages of 2×10^{12} to 2×10^{14} neutrons/cm² which is equivalent to the two years of radiation a FPGA chip will receive on the Mu2e detector. The resulting firmware provides a reliable and cost-efficient way to test the functionality of FPGA chips after having undergone harsh conditions that are not limited to irradiation. This research successfully predicted the radiation tolerance level of FPGA chips and supports the hypothesis that a radiation dosage of 2×10^{13} n/cm² is safe for the FPGA chips to be used in the Mu2e project.

I09**Automatic Compensation for Cable Time Delay in Field Programmable Gate Arrays****Presenter(s)**

Stephanie Wang, Illinois Mathematics and Science Academy

Advisor(s)

Jinyuan Wu, Fermi National Accelerator Laboratory

FPGAs are susceptible to delay in information delivery. Delays between sending and receiving, results from numerous factors which can impact the reliability and integrity of an FPGA's data collection. Time delay can cause inconsistency in data collected. This design project endeavored to develop an effective method of determining and compensating for time delay between sending and receiving modules. Designing and building a firmware required ALTERA's circuit design building program (Quartus II 9.1 sp2 Web Edition) and Cyclone III FPGA chips. The circuit description consists of two major types of logic blocks: phase-locked loops (PLL) and time-to-digital converter (TDC) blocks. Using PLL, clock skew caused by unstable communication signals can be minimized. Using TDC, cable delay can be compensated for. Combined, the final circuit description can align both the leading edge and mean-time reference of the sending and receiving signals. The final circuit description allows automatic compensation for time delay from cables by realigning the sending and receiving signals to share the same mean time reference. As a research and development project, the description may be ported to other larger designs where code is shared.

I10**Trapezoidal Clocking in Maintaining Isochronous Circuits****Presenter(s)**

Kevin Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Jin Wu, Fermi National Accelerator Laboratory

Clocking schemes within circuits are crucial to ensuring that all signals are transmitted and received at the correct time. Within large detectors, built for responding to the smallest pieces of matter, any small malfunction in the clock distribution could cause missed detections and false alarms. A completely isochronous circuit is therefore crucial, and factors affecting the clock distribution include heat, cable length, and cable loss. This paper examines trapezoidal clocking as a possible solution. Trapezoidal clocking uses trapezoidal pulses and sums the leading and trailing slopes to create a new waveform with isochronal zero crossings. Trapezoidal clocking can also be achieved with lossless cables and any odd function's pulses, not only trapezoidal pulses. By using a series of field programmable gated arrays, we were able to test the effectiveness of the trapezoidal clocking system in maintaining an effective, isochronous circuit. Looking at data collected from oscilloscopes, we find that trapezoidal clocking does maintain isochronous signals.

J01**Science Fiction and Fantasy Genre Devices Allow Authors' Self-Expression****Presenter(s)**

Kirstyn Carlson, Illinois Mathematics and Science Academy

Advisor(s)

Tracy Townsend, Illinois Mathematics and Science Academy

Science fiction and fantasy allow us to express ourselves more easily, permitting authors to insert commentary on our society hidden within their work. In this investigation, works by various writers from these genres were read in order to evaluate if science fiction and fantasy better lend themselves to a more liberal form of expression than mainstream fiction. The final list consisted of Isaac Asimov, Ursula LeGuin, Peter Beagle, and Neil Gaiman. These authors were chosen based on the availability of biographical information and short, manageable stories. From here, the authors' biographies were searched for significant life experiences, personality traits, and portrayals of themselves within their work. A working definition of science fiction and fantasy was formed. The stories were then analyzed for allegorical and symbolic meaning. Further study in this field advances our knowledge in the creative mind and allows us to further understand these authors and their chosen genres. This study is important because it allows us to expand our understanding of science fiction and fantasy and why authors are drawn to these genres versus the mainstream.

J02**The Methods of Characterization and Plot Development of an Adult Level Science Fiction Novel****Presenter(s)**

Alexander Johnson, Illinois Mathematics and Science Academy

Advisor(s)

Erin Micklo, Illinois Mathematics and Science Academy

My study was based on writing fifty pages of a science fiction novel in order to study characterization and plot development therein, alongside external research. The results produced detailed information about characterization and plot development. The former was found to be built by a character's actions, dialogue, thoughts, and description, from most to least effective in that order. I learned specific methods such as flashbacks, high pressure decisions, and dialogue-driven conflict to accomplish this. Plot development was driven by a loop from the environment and other characters making an effect, characters reacting to it, something else happening, and then characters reflecting and possibly changing because of it. Specific methods learned to accomplish this include a character accidentally making a change, misinterpretation of events, and contrasting beliefs emerging across numerous characters. A duality was found between the two, where plot was driven by characters, and characters came to fruition through the plot. These results illustrate the mechanisms utilized by all works of literature to portray realistic characters in an interesting plot, while keeping the reader interested and entertained throughout.

J03**Blood Money: Death, Financial Gain, and Morality in the Gothic Novel****Presenter(s)**

Anna Melberg, Illinois Mathematics and Science Academy

Advisor(s)

Adam Kotlarczyk, Illinois Mathematics and Science Academy

Gothic literature has evolved from its German bone rattling and chain shaking origins seen in *The Castle of Otranto* (1764) to psychological horror made famous by Edgar Allen Poe to disillusioning southern gothic novels such as *Absalom, Absalom!* (1936) by William Faulkner and into modern iterations exemplified by *Blood Meridian* (1985) by Cormac McCarthy. I examine a relationship between literature and economics defined by Michael Watts in *The Literary Book of Economics*. Using a New Historical approach to review twelve geographically and temporally diverse gothic novels, I identify economic gains made by characters. I find that the roots of these gains are the deaths of innocent, secondary characters who fall in the crossfire of the fight between the villain and the hero. Fallen characters who are perceived as evil still yield economic gain to the protagonists, but these rewards have their own consequences on the main characters' lives. This study concludes that the deaths of minor characters lead to substantial increases in wealth, suggesting that life has a monetary value, and that the integrity of the deceased correlates with the size of the fortune inherited by the protagonist.

J04**The Written Aspect Analysis of Performance Poetry****Presenter(s)**

Addison Schwaller, Illinois Mathematics and Science Academy

Advisor(s)

Daniel Gleason, Illinois Mathematics and Science Academy

Poetry is found in many media and locations, such as poetry readings and slam competitions. Performance poetry is known for its lively, theatrical style of presentation. Instead of analyzing the performance aspect, this study recorded and analyzed the occurrence of literary devices contained in the written aspect of performance poetry; that data set was compared to that of selected printed poetry. The performance poems were selected if a video of their performance had an average of over sixty thousand views a year. The transcripts were examined so that literary characteristics in each poem could be compared. The current data shows that all poems included enriching poetical devices, and, in fact, performance poems averaged more of these overall than printed poems. This counters the popular belief that the strongest part of performance poetry lies in the performance; if a poem is composed poorly, the performance is not likely to substitute. Through data collection it has been noted that poetic styles differ from one another in the sample; differing amounts of various literary devices are utilized. Performance poetry does not lack these devices when compared to the rich literary devices normally associated solely with printed poetry.

K01**The Effects of Brand Name Root Stimulants Versus Their Active Ingredients on Germinated Corn Plants****Presenter(s)**

Simone Alexandrova, Illinois Mathematics and Science Academy

Marco Medina, Illinois Mathematics and Science Academy

Advisor(s)

Julie Polz, Illinois Mathematics and Science Academy

For many years farmers and plant enthusiasts have looked for methods that will yield the biggest, healthiest plants, in the shortest time. We have looked for cheaper alternatives to what these planters are currently using. We researched and chose to use the most popular and best-rated root stimulants as well as their active ingredients. We then grew corn plants, waiting for them to germinate before beginning to water them with the commercial root stimulant solutions and their active ingredient counterparts. Each trial lasted approximately six weeks, during which we tracked the plants' growth by taking them out of the vermiculite and replanting them after measuring their mass, root length and total length (the combined root and stem length). In general, plants grown using just the active ingredient solutions were healthiest, having the longest lengths and heaviest masses. For example, the brand name root stimulant RootBoost had an average total length of 163 mm. In comparison, the plants watered with vitamin B1 (the active ingredient in RootBoost) had an average total length of 417 mm. Since it is cheaper to manufacture these individual active ingredients, planters could save a lot of money by switching to them.

K02**A Comparison in Environmental Education: Aurora, Illinois and Beijing, China****Presenter(s)**

Lydia Auch, Illinois Mathematics and Science Academy
Grace DiCecco, Illinois Mathematics and Science Academy
Kenzo Esquivel, Illinois Mathematics and Science Academy

Advisor(s)

Glenn "Max" McGee, Illinois Mathematics and Science Academy
Aracelys Rios, Illinois Mathematics and Science Academy

As climate change threatens to alter every aspect of society, environmental awareness is extremely relevant to our world. The Illinois Mathematics and Science Academy (IMSA) and the High School Affiliated to Renmin University of China (RDFZ), as premier residential schools, have a responsibility to instruct their students on how to positively influence people in order to improve the quality of life on our planet. We, with collaboration from RDFZ students, assessed the carbon footprint of school buildings and examined environmental education programs and legislation. Through comparison of greenhouse gas emissions we found that at IMSA we produced a larger footprint than our counterparts in Beijing. However, differences could be explained by the type of building measured as well as measurement procedures. In addition, through our review of current environmental education programs and legislation in Illinois, we found that while programs are in place, many consist of suggestions and lack mandatory aspects, which prevents maximum efficacy. From our research we were able to provide recommendations on improving the environmental literacy with implications for the larger state of environmental education; reducing the carbon footprint of IMSA residence halls through their renovation; and implementing effective initiatives to increase student awareness.

K03

Increasing Diversity in the Illinois Mathematics and Science Academy Prairie: Preliminary Findings

Presenter(s)

Sarah Blanco, Illinois Mathematics and Science Academy
Clare Leahy, Illinois Mathematics and Science Academy

Advisor(s)

Jean Bigger, Illinois Mathematics and Science Academy
Donald Dosch, Illinois Mathematics and Science Academy

The restoration of the IMSA Prairie contributes to the effort of reestablishing native Illinois environments. As a continuation of last year's project, we identified plants and researched possible additions for expansion. We additionally burned the prairie for the second time in three years. We assembled a group of volunteers and burned based on methods typical in prairie burns. We identified plants using images of prairie specimens and field guides and consulted a variety of literary sources for researching new plants. We also added an additional nineteen plants to the IMSA Prairie Digital Field Guide, with twelve plants in the process of identification, and are working to standardize entries in the Field Guide. We also compiled a list of eleven potential plants beneficial for the prairie's diversity and are currently mapping where to plant these based on elevation maps. The effects of the burn will not be fully assessed until next year, but our initial assessment supplemented by additional research is that subsequent burns should take place in the spring to maximize effectiveness. As for plant additions, plants suited for moist environments should be placed in the prairie slough while those suitable for drier environments should be planted on the slopes.

K04

Building an Efficient Egg-Based Antibacterial Water Filter

Presenter(s)

Anna Gupta, Illinois Mathematics and Science Academy
David Lisk, Illinois Mathematics and Science Academy

Advisor(s)

Mark Carlson, Illinois Mathematics and Science Academy

For over a billion people in developing countries, lack of sanitary water results in needless suffering and death. In this investigation, our goal was to create a filter that would kill 99.9% of bacteria, produce 40 L of water per day, and cost under \$15. In order to construct this, we used the egg whites from one egg, added approximately 30 ml of 0.1 M silver nitrate solution, poured the solution into a three inch diameter plastic pipe with stainless steel mesh glued to the bottom, and lightly baked the filter. Kill rates were determined by plating and counting the surviving *Escherichia coli* bacteria. In testing, our filters had kill rates above the target, 99.9%, but had insufficient flow rates, below 0.25 L per day. Added hydrostatic pressure, from 0.01 to 0.19 atm, subsequently improved the flow rates to 1-2 L per day. however, excessive pressure extruded the egg patty and destroyed the filter. Determination of the kill rates under increased pressure is ongoing. In addition, the filters also deteriorated and ceased to filter water if they were left at room temperature without a sealed container for several days. Going forward, we seek to improve our filter by increasing flow rate and improving the lifespan of the filter so that it can be used for several months.

K05**Investigating the Feasibility of Green Roofs for Residential Applications****Presenter(s)**

Anna Kryczka, Illinois Mathematics and Science Academy

Advisor(s)

Peter Clancy, Illinois Mathematics and Science Academy

Green roofs, a form of sustainable architecture, benefit the environment because they filter storm water, reduce runoff, remove carbon dioxide from the air, reduce the urban heat island effect and last longer than conventional roofs. Despite these advantages, green roofs have struggled to gain popularity, especially in residential settings. To assess the efficiency of sloped green roofs, we constructed roof models and compared the water retention capacity of a conventional model and various green roof models during simulated rainfall. Also, by heating the attic space of the model and measuring temperature response, we were able to calculate the R-value of a green roof in comparison to a conventional roof. Currently, further experimentation is needed to achieve conclusive results. If we conclude that the sloped green roof models have a significantly higher water retention capacity and better isolative properties than conventional roofs, then this may indicate that green roofs are an efficient form of architecture even on sloped roofs. Since many residential roofs are sloped, this study would advocate the feasibility of installing green roofs on residential buildings.

K06**Influence of the Media on the Public Perception of Alternative Energy****Presenter(s)**

Earl Justin Mangulabnan, Illinois Mathematics and Science Academy

Scott Zelman, Illinois Mathematics and Science Academy

Advisor(s)

Robert Kiely, Illinois Mathematics and Science Academy

The American public's perception of varied alternative energy strategies is heavily influenced by the media. However, different media outlets often have financial or political motives that affect their portrayal of specific issues. This study explores three different types of alternative energy: solar power, nuclear energy, and hydraulic fracturing. Each of these energy strategies has recently received significant media attention. The Japanese nuclear crisis and the bankruptcy of Solyndra drew significant news coverage, and hydraulic fracturing was treated in *Promised Land*, a recent film. We analyze how each story is portrayed by the media, and how it may have influenced American citizens and politicians. We observed that the information released to the public is highly dependent on the political affiliation of the news source. From the data gathered by this study, it cannot be determined that American governmental actions are actually determined by the media. However, one could argue that many of the government's decisions in response to the aforementioned alternative energy events may have been made solely for the purpose of quelling public unrest caused by the media. As a result, we believe our study raises important questions.

K07**Sustaining Plant Growth With an LED Array****Presenter(s)**

Anthony Ortiz, Illinois Mathematics and Science Academy

Advisor(s)

Jason Fatten, Ball Horticultural Company

Will Healy, Ball Horticultural Company

Margi Werderich, Ball Horticultural Company

One main variable a greenhouse grower cannot control is the sunlight intake of a plant or flower. The goal of my project was to make an inexpensive array of LEDs that successfully controlled the light intake. I built an array of LEDs and used a spectroradiometer to see the light intensity and different points on the array. My initial readings on the edges of the array were between 50-70 PAR, and the readings in the middle of the array were 100-110 PAR. I rearranged the lights so that the readings throughout all points on the array were within 90-110 PAR. PAR stands for Photosynthetically Active Radiation, and is the integral of power from 400-700nm in micromoles per square meter per second. Another factor I measured is the heat the lights gave off and the amount of voltage used by the lights. Those measurements are being made. Even before I embarked on this project, I knew that LED lights were a potential option for greenhouse growers; by the end of my project, however, I will be able to determine if my method is both efficient and sustainable.

K08**Enumeration of Microorganisms in Anaerobic Digesters Using Fluorescent *In Situ* Hybridization****Presenter(s)**

Shreya Santhanam, Illinois Mathematics and Science Academy

Advisor(s)

Krishna Pagilla, Illinois Institute of Technology

Jai Prakash, Illinois Institute of Technology

Fluorescent *in situ* hybridization (FISH) is a culture-independent approach that allows for the phylogenetic identification, enumeration, and spatial arrangement of microorganisms. Using FISH one can enumerate the amount of archaea and bacteria in anaerobic digester samples from a wastewater treatment facility. The samples were fixed and then hybridized with fluorescent oligonucleotide probes. Then images of the samples were taken using microscopy, and the amount of archaea and bacteria was counted. The overall ratio of archaea to bacteria found in the samples was 284:289, almost 1:1. The results support that archaea and bacteria work together in order to accomplish methanogenesis in the anaerobic digester.

K09**Engineering a Better Phytoremediator****Presenter(s)**

Samuel Walder, Illinois Mathematics and Science Academy

Advisor(s)

Glenn "Max" McGee, Illinois Mathematics and Science Academy

Aracelys Rios, Illinois Mathematics and Science Academy

Phytoremediation is the removal of wastes from natural systems using plants. Phytoremediation of heavy metals in water can be equally effective as traditional, expensive chemical methods. To find what makes a good phytoremediator and how current phytoremediators can be improved upon, twenty-four *Eichornia crassipes*, *Typha domingensis*, and *Chlorophytum comosum* hyperaccumulators were grown at IMSA and a school in Beijing (RDFZ). Each plant's growth potential was restricted at a selected point, root, leaf, or stem, and introduced to Cu^2 ions. After analyzing the amount of waste removed per plant, we found that phytoremediation is locked in the root system; large, fast-growing root systems are the key to phytoremediation. In addition, large leaves and thick stems do not increase phytoremediation. These results mean that some plants which might be considered good phytoremediators, like large willows, may in fact be less efficient than counterparts with lower biomass but high root-to-plant biomass ratios, like *Sedum alfredii*. These results have implications for the development of artificial phytoremediators produced through genetic modification or man-made materials. High root-to-biomass ratio artificial phytoremediators may represent a more effective, less costly option for waste-water treatment than translocation-based systems.

L01**Examining Radical Ideology Among Immigrant Workers in Gilded Age and Progressive Era Chicago****Presenter(s)**

Nathan Huxtable, Illinois Mathematics and Science Academy

Advisor(s)

Eric Smith, Illinois Mathematics and Science Academy

Chicago's Gilded Age and Progressive Era contained significant political and socioeconomic contributions from radical organizations. However, these groups failed to capture the pervasive support of immigrant worker populations in Chicago, suggesting to scholars that immigrants accepted the capitalistic social structure. Yet by drawing upon primary and secondary literature in a case study of these Chicago workers, these conjectures fail to characterize Chicago's radical-labor relationships. Instead, a few distinct patterns emerge. Firstly, the immigrants of Packingtown and other ethnic neighborhoods did not accept capitalism as a way of life. The presence of Chicago's radical organizations and worker participation in labor organizations indicated a lack of simple acceptance of capitalistic socioeconomic structure. Second, the efforts of radical organizations to organize workers proved insufficient, as worker participation in radical groups lacked the influence to inspire a more pervasive support base. Finally, immigrants became too divided as a population to exact any social change. The division of labor, substantial re-immigration rates, and the social dynamics of ethnic neighborhoods contributed to this fractionalization. Moreover, these interactions conveyed the dynamism of Gilded Age and Progressive Era labor relations. In a society of ever-changing political and social dynamics, looking back in Chicago's past provides a lesson in social organization.

L02

A Study on the Universality of the Universal Declaration of Human Rights

Presenter(s)

Jameson O'Reilly, Illinois Mathematics and Science Academy

Advisor(s)

Christian Nokkentved, Illinois Mathematics and Science Academy

Since its adoption by the United Nations General Assembly in 1948, the Universal Declaration of Human Rights (UDHR), signed by all UN member states, has played a key role in human rights law and advocacy. The purpose of this investigation was to determine whether it truly deserves the title of Universal. The investigation began by using literature review and database searches to take a look at several of the global belief systems in direct conflict with the UDHR, including Islam, Asian values, and conscientious objection. It was found that many of these systems had only very specific objections to the Declaration, and that a majority of the content of the document is uncontested. Although it is based on the values of the Enlightenment in Western developed nations, people globally are calling for their rights as outlined in the UN's Declaration. In fact, every nation recognized by the United Nations is held up to the standards that the Declaration outlines, and it has been translated into over four hundred languages, the most of any document. By examining these facts, this study helps to reinforce the concept that all men, women, and children are created equally and are deserving of the same rights.

M01

Model of the Spread of West Nile Virus Outbreaks in the United States Based on Rate of Human Incidences

Presenter(s)

Andrew Alonso-Emanuel, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Richard Stalmack, Illinois Mathematics and Science Academy

West Nile Virus has recently been in the news because the United States has been hit with the largest outbreak ever since West Nile was first recorded in 1999. West Nile Virus outbreaks have been studied extensively by the Centers for Disease Control and Prevention, but focus on high population density areas. In previous studies it was found that urbanized and agricultural habitats have the highest transmission rates for the virus. Rather than using a traditional model based upon number of cases in an area, I created a model using percent infected in an area. Areas with lower population that initially appeared to be almost unaffected in a traditional map show different results with higher infection rates.

M02**Understanding the Dimensions of String Theory: The Betti Numbers of Calabi-Yau Manifolds****Presenter(s)**

Lael Costa, Illinois Mathematics and Science Academy

Advisor(s)

Eric Zaslow, Northwestern University

Many string theorists believe that the universe exists in ten dimensions of space-time. These are the familiar four, along with an additional six that are compactified into tiny manifolds, causing distortion on the subatomic level. We wished to better our understanding of the topological properties of those manifolds, called Calabi-Yau manifolds, which are complex manifolds with the complex equivalent of orientability. For this investigation, we are using the programming language Sage to build an algorithm that computes the Betti numbers of a given polytope or space. The Betti numbers are a set of topological invariants that refer to the number of unconnected spaces of given dimension. When it is finished, we will apply the program to Calabi-Yau manifolds to expand our knowledge of the manifolds and gain a better understanding for the mathematics of string theory. We have been working on the program as well as on finding the Betti numbers of certain simpler Calabi-Yau manifolds by hand, such as the n -torus. A topological understanding is key to analyzing such spaces rigorously. Our research will add to the knowledge base regarding mathematical support for string theory.

M03**Using Geometry to Parameterize Rational Solutions to Algebraic Equations****Presenter(s)**

Kevin He, Illinois Mathematics and Science Academy

Advisor(s)

Izzet Coskun, University of Illinois at Chicago

In mathematics, finding solutions to difficult problems often requires the use of multiple perspectives. Algebraic geometry demonstrates a great example, as geometry motivates methods for solving algebraic equations. For example, quadratic equations can be solved using projection from a point. In this project, we used parameters, or new variables used to express functions in different ways, to find solutions of low degree equations in \mathbb{R}^2 using certain points on the corresponding curves. The points we used were singularities, or solutions at which the curve crossed itself, for example, by looping. More specifically, we parameterized quadratics, cubics with a node, quartics (polynomials of degree four) with three nodes, quintics (polynomials of degree five) with six nodes, and quintics with three nodes and a triple point. We are currently trying to generalize these methods to higher degree polynomials. Our study shows the importance of singularities in understanding solutions of algebraic equations. It also shows how many seemingly distinct fields in mathematics share common ideas and can be synthesized in an effective and useful manner.

M04**Predicting a Breakout Season for Major League Baseball Players****Presenter(s)**

Samuel Kaufman, Illinois Mathematics and Science Academy
Matthew Tennenhouse, Illinois Mathematics and Science Academy

Advisor(s)

Christopher Kolar, Illinois Mathematics and Science Academy

Sabermetrics is the search for objective knowledge, and the pinnacle of sabermetric aspirations is to predict player's future performance. By cross-referencing past predictions with other projection systems such as Marcel and PECOTA with the actual outcomes, we have determined each system's reliability and hope to create a composite system that is more accurate than any of these individual components. This type of work has implications in numerous fields in which prediction systems are common; a data analyst could use these methods in order to create better predictions while personally using less computational power. This enhanced projection system would be used to predict whether or not player X would have a breakout season in a given year. We defined a breakout season as a player having a spike in performance of more than twenty percent from the previous season in terms of runs created. Our enhanced projection system could potentially help baseball programs improve development of rising players and may even improve fantasy baseball owners' draft capabilities.

M05**Asymmetric Nature of Wireless Communications****Presenter(s)**

Evan Li, Illinois Mathematics and Science Academy

Advisor(s)

Peng-Jun Wan, Illinois Institute of Technology

Interference is a fundamental property of wireless communications. It has the following asymmetric nature: A group of links may transmit successfully at the same time, but their reverses, which are typically used for the acknowledgements of the receptions, may not. In this project, I investigate such asymmetric nature of wireless interference. Suppose that the interference radius of each wireless link is c times its length for some constant $c > 1$. For c greater than or equal to $1 + \sqrt{2}$, I have discovered that for any positive integer n , there is a group of n links which can be transmitted successfully, but their reverses have pairwise interference. As the result, their reverses have to transmit one by one. When c is less than $1 + \sqrt{2}$, it remains open whether such scenario can happen or not. The findings could lead to deeper insight into the asymmetric nature of wireless interference and help on the design of wireless communication protocols.

M06**The Application of Markov Chains in Granite Formations****Presenter(s)**

Suraj Sinha, Illinois Mathematics and Science Academy

Advisor(s)

Somak Dutta, University of Chicago

Debashis Mondal, University of Chicago

When granite structures are formed under completely ideal conditions, the granular structures are organized in the pattern of a reversible Markov Chain. When these ideal conditions are tampered with, the structure of the granite is no longer organized in the pattern formed by a reversible Markov Chain. Various methods can be used to test data similarity in the statistical world. The aim of this investigation was to prove that Markov Chains are the most accurate method of representing the patterns present in these granite structures. Various situations in the natural world require various modes of representation, for example, in the situation of a coin flip, the Bernoulli Process is the most accurate method of predicting the next outcome since every event in this experiment is independent; in the case of more complex instances such as rain fall, it is evident that the events in the experiment are not independent and are in fact, dependent upon each other. In order to put this dependency into consideration, Markov Chains are optimal because they consider the probability of transition from one step to another. Through this investigation, I have explored whether the formation of granite structures can be adequately represented by Markov Chains.

N01

Examining Asthma Prevalence and Improving Medication Access in Chicago Public Schools

Presenter(s)

Prachi Aggarwal, Illinois Mathematics and Science Academy
Jenson Phung, Illinois Mathematics and Science Academy
Shreya Santhanam, Illinois Mathematics and Science Academy

Advisor(s)

Ashley Dyer, Northwestern University
Ruchi Gupta, Northwestern University
Chris Warren, Northwestern University
Emily Zadikoff, Northwestern University

The goal of this investigation was to increase awareness of asthma prevalence in Chicago Public Schools (CPS) and describe the current asthma reporting process. Data regarding student medical status were collected from two sources: 1) CPS health information database; and 2) student medical information forms (SMI). Focus groups were also conducted with CPS parents to gain qualitative data regarding the effectiveness of current CPS reporting procedures. Findings suggest that discrepancies exist between the prevalence rates determined from collected data and current prevalence rates reported in CPS, which are determined by cases of physician verified asthma. When comparing physician verified asthma to reported asthma for CPS students (N = 3947) across five schools, the latter rate was higher (Alcott: 2.75% of students with physician verified asthma versus 5.89% students with asthma reported via other methods, LaSalle II: 7.37% versus 10.58%, Onahan: 1.49% versus 7.54%, Hibbard: 3.19% versus 7.01%, and Hedges: 4.39 versus 8.67%). Based on our results, it is recommended that CPS consider alternate methods of asthma reporting when determining prevalence rates and that all schools annually distribute SMI forms to every student. We recommend establishing better communication between parents and staff to increase education about the asthma reporting process.

N02

The Impact of Narcolepsy on Self-Image and Quality of Life in Young Adults

Presenter(s)

Charlene Angeles, Illinois Mathematics and Science Academy

Advisor(s)

Mary Kapella, University of Illinois at Chicago

A person suffering from the chronic neurologic disorder narcolepsy is characterized by stigmatizing symptoms such as excessive daytime sleepiness, cataplexy attacks, hypnogogic hallucinations, and sleep paralysis. Initial onset of the symptoms usually appears during young adulthood disrupting a person's education and beginnings of a career; this investigation examines the social impact and stigma caused by the development of narcolepsy during adolescence. A sample consisting of 124 adults with narcolepsy and 92 healthy controls completed a questionnaire consisting of the Stigma and Social Impact Scale (SSIS), the Hospital Anxiety and Depression Scale, and the Short Form Health Survey (SF-36). Descriptive statistics among other statistical analyses were used to investigate relationships among variables. Significant differences in SSIS, financial insecurity, internalized shame, and social isolation were found in addition to the narcoleptic subjects scoring consistently lower in SF-36 physical function, role emotional, and mental health. This investigation found young adults with narcolepsy report an overall lower quality of life and higher feeling of stigmatization than healthy individuals.

N03

Uncovering the Role of PTEN in Mediating the Decrease of Pancreatic Inflammation Signals by Omega-3 Fatty Acids

Presenter(s)

Ryan Chiu, Illinois Mathematics and Science Academy

Advisor(s)

Paul Grippo, Northwestern University

Development of pre-cancerous conditions is largely attributed to increases in levels of pAkt, a pro-growth protein negatively correlated with levels of omega-3 fatty acids in the pancreas. Phosphatase and tensin homolog (*PTEN*), a tumor suppressor phosphatase gene mutated in 70% of human cancers, inhibits excess phosphorylation of protein Akt. The interaction between omega-3 and *PTEN* was investigated, using pancreatic ductal (HPDE) cells dosed with fatty acids. Half of the cells were blocked with *PTEN* inhibitor, and the other half were used as controls. The initial hypothesis was that omega-3 increases levels of *PTEN*, but our results revealed that protein expression of *PTEN* stayed constant. *PTEN* was then inhibited, in order to test if it was necessary for decreasing pAkt levels with omega-3 fatty acids. Cells treated with omega-3 fatty acids and a *PTEN* inhibitor exhibited higher levels of pAkt compared to cells treated with omega-3 without the inhibitor, signifying the necessity of *PTEN* in suppressing phosphorylation of Akt. Since omega-3 dietary supplements were previously regarded as a preventative measure against pancreatic premalignant lesions, this study serves to address the efficiency of such measures. Since *PTEN* is necessary, but mutated in a majority of patients, these supplements would work better with the restoration of *PTEN*.

N04

A Population-Based Approach to Define Risks Associated with Variable Hepatitis C Treatment Response in Individuals Coinfected with Human Immunodeficiency Virus

Presenter(s)

Kevin Emancipator, Illinois Mathematics and Science Academy

Gina Liu, Illinois Mathematics and Science Academy

Advisor(s)

Sudhir Penugonda, Northwestern University

Chronic infection with hepatitis C virus (HCV), a liver-specific infection, can eventually lead to various forms of tissue damage. Moreover, specifically coinfection with human immunodeficiency virus 1 (HIV-1) accentuates the disease process and may reduce HCV treatment efficacy. The experimenters attempted to create a model stratifying major viral and host risk-factors which may contribute to variable response to HCV treatment. Clinical data from patients with both HCV and HIV-1 were analyzed in an effort to quantify the effect of coinfection and identify the associated risk-factors. Variables included in our model address demographic data, the presence of other diseases, and hepatitis-related laboratory values in relation to benchmarks of disease progression quantified in terms of tissue damage sustained. Eighty coinfecting patients were examined; sixty-eight were treated and sixteen failed treatment. The median CD4 T-cell count was 443 cells/ μ l. Male gender was significantly associated with treatment failure ($p = 0.029$). White race ($p < 0.005$) and presence of hepatitis B surface antibody ($p = 0.045$) was associated with clearance. A clearer picture will emerge as further data is obtained. Importantly, current results do not stray from available literature. This study will inform the follow-up *in vitro* and *ex vivo* experiments to further define any association.

N05

The Role of Serum Free Light Chain Assays for Diagnosis and Monitoring of Myeloma

Presenter(s)

Arjun Garg, Illinois Mathematics and Science Academy

Advisor(s)

Sairah Alvi, The Binding Site

M-protein is the monoclonal immunoglobulin produced in large quantities in patients with plasma cell disorders. In the past, serological tests to identify M-protein in patients with multiple myeloma and other plasma cell disorders included a serum and urine protein electrophoresis, and serum and urine immunofixation electrophoresis. Serological tests typically can only measure M-protein qualitatively. The serum-free light chain (FLC) assay (Freelite) provides a much more thorough analysis of the M-protein. Through studying the literature, I determined that the FLC assay has a major role in detecting multiple myeloma and related plasma cell disorders with its in-depth quantized data. Compared to other available assays, the sensitivity of the FLC assay is superior, allowing detection within the normal range. A panel of FLC testing in combination with either serum protein electrophoresis or serum immunofixation obviated the need to do 24 hour urine testing in the screening panel for plasma cell disorder. With an effective method of diagnosis for multiple myeloma, patients can begin treatment before complications of the disease arise.

N06

Poloxamer 188 as a Repair for Apoptosis

Presenter(s)

Aaron Geldner, Illinois Mathematics and Science Academy

Advisor(s)

Lisa Hoffman, University of Chicago

Rapheal Lee, University of Chicago

It has been shown that with MDCK cells, Poloxamer 188 (P-188), can repair cell damage in necrotic cells. We wanted to see if the same would occur with cells in apoptosis, which is a form of programmed cell death. We found that over time we could induce apoptosis in MDCK cells using detergents to damage the cell membrane. We used two different detergents, Triton-X 100 and saponin. After applying the detergents for 30 minutes, we applied P-188. We ran Western blots to make sure that the cells were under going apoptosis. We also used DNA laddering to determine how much cleaved DNA was present. If DNA laddering was present, then it meant that apoptosis had occurred, yet the intensity of the bands showed how damaged the cells were. We found that cells treated with Triton-X 100 did show DNA laddering, and the samples treated with both the Triton and the P-188 had much less intense bands. This suggests that P-188 does repair cells that are in apoptosis. Cells can often undergo apoptosis after blunt force trauma, so these findings could help new wound healing treatments.

N07**Healthcare Providers' Motivations for Hand Hygiene Compliance****Presenter(s)**

Annika Gomez, Illinois Mathematics and Science Academy

Advisor(s)

Emily Mawdsley, University of Chicago

This study investigates the thoughts behind adherence to hand hygiene (HH) regulations. Physicians and nurses working in intensive care units were asked a series of questions concerning their hand hygiene compliance and it was noted whether or not they washed their hands. A total of ninety-six health professionals were interviewed, sixty-six nurses and thirty physicians. Nurses were observed to have a HH compliance rate of 37.879%, physicians' was 40%, making for a total compliance rate of 38.542%. When asked the greatest factor which deterred them from washing their hands, 28.8% of noncompliant and 5.4% of compliant participants cited availability of hand gel dispensers as an issue ($p=0.0072$). 10.2% of noncompliant and 45.9% compliant participants cited patient emergency as a deterrent ($p=0.0002$). When asked what motivated them to wash their hands, 32.2% of noncompliant participants cited patient safety. Only 8.1% of compliant participants had similar answers ($p=0.0063$). When asked when they most wash their hands, 86.5% of compliant participants answered exit, while 54.2% of noncompliant participants answered exit ($p=0.0016$). Significant differences were demonstrated between responses from those who were observed to wash their hands (compliant) and those who were not (noncompliant). These results can help further the understanding of HH habits and lead to more thorough promotion of HH compliance.

N08**Elucidating Gastrokine Function in NSAID-Induced Inflammation via Myeloperoxidase Staining****Presenter(s)**

Tejas Joshi, Illinois Mathematics and Science Academy

Advisor(s)

David Boone, University of Chicago

Wes Grimm, University of Chicago

Gastrokine-1 (GKN) is a protein thought to be exclusively produced by the stomach, but the specific functions of this protein in non-steroidal anti-inflammatory drug (NSAID) induced stomach injury are not known. NSAIDs are known to injure stomach epithelium and trigger inflammation characterized by presence of neutrophils. Neutrophils contribute to inflammation by producing the peroxidase enzyme myeloperoxidase (MPO). We hypothesize that GKN protects the stomach against inflammation from NSAIDs such as piroxicam. To understand the function of GKN in NSAID induced injury we treated gastrokine knockout mice with piroxicam for three days and then evaluated the degree of inflammation by staining stomach tissue for myeloperoxidase. The stomachs of these mice were removed and sectioned onto slides. Those slides were fluorescently stained for MPO and photographed, and the images were then analyzed qualitatively and quantitatively. We predict increased expression of MPO in the knockout mice over controls. This result would suggest that gastrokine-1 has a protective effect against NSAID-induced injury in the stomach.

N09

Retrospective Analysis of Pediatric Patients With Chronic Graft-Versus-Host Disease Concerning Predisposing Factors, Response to Therapy, Survival, and Outcome

Presenter(s)

Kaylee Kauffman, Illinois Mathematics and Science Academy

Advisor(s)

Morris Kletzel, Lurie Children's Hospital of Chicago

Chronic graft-versus-host disease (cGVHD) is the most common and most severe long-term complication that can occur after one has undergone allogeneic hematopoietic stem cell transplantation (HCT). Not much is known about cGVHD in children, and most of the research on the topic has been done at single institutions with a small number of patients. The files of forty-six pediatric patients who underwent an allogeneic HCT and later suffered the complication cGVHD at the Lurie Children's Hospital of Chicago were used to collect and analyze data to search for possible indicators pre- and post-transplant that a patient would develop cGVHD and for more information about the complication and its behavior in children. We used two separate databases and both paper and electronic files for the data on the patients, and compiled it all onto an Excel spreadsheet. Then, using descriptive statistics techniques, we analyzed the data. Our results suggest that the factors that may most contribute to the development of cGVHD include the use of alternative donors, the degree of match, and the age of both donor and recipient. Further data analysis is currently underway, though it is already obvious that new approaches to cGVHD prevention and treatment are necessary.

N10

Studying the Mechanisms Through Which NKG2D Receptor Stimulation Induces CD8 T-cell Survival in the Tumor Environment

Presenter(s)

Akram Khaja, Illinois Mathematics and Science Academy

Advisor(s)

Jose Alejandro Guevara, Loyola University

Tumors exist in hypoxic, low glucose environments that inhibit the survival of other cell types. It has been shown that activation of the NKG2D receptor may induce CD8 T-cell survival in tumor conditions, thereby allowing them to destroy tumor cells and limit tumor growth. Immunodeficient mice were given a matrigel tumor and injected with the Rae1-e ligand for the NKG2D receptor to test for specific effects of NKG2D activation. Real-time PCR, Western blots, and a microarray analysis were used to analyze the change in DNA and protein expression in the mice of important survival genes for tumor conditions. It was found that NKG2D stimulation increased expression of some pertinent metabolic proteins including glucose transporter 1, lactate dehydrogenase, and hexokinase, implying a change from oxidative reduction to glycolysis in CD8 T-cells that would require less oxygen and mediate survival in tumor conditions. Decreased exhaustion markers such as T-bet (transcription factor), mammalian target of rapamycin (mTOR), and pyruvate dehydrogenase lipoamide kinase isozyme 1 may also imply greater survival. Finally, it was found that telomerase components may have changed expression with NKG2D activation as well. The data suggests that NKG2D activation may lead to changes that increase CD8 T-cell survivability. However, further research may help uncover the exact pathway and move towards solving the problems of cancer.

N11

Characterizing Melanoma Stem Cell Responses to 8-OH-DPAT

Presenter(s)

Anna Krzywiec, Illinois Mathematics and Science Academy

Advisor(s)

Jonathan Eby, Loyola University

Caroline Le Poole, Loyola University

Kristin Willenborg, Loyola University

Monobenzyl ether of hydroquinone (MBEH) was shown to selectively remove melanocytes from the skin and serves as a treatment for melanoma. However, some patients exposed to MBEH show repigmentation, possibly due to its inability to eradicate melanocyte stem cell populations. Recent studies show that 8-hydroxy-2-di-n-propylamino tetralin (8-DPAT) prevents melanocyte development in the neural crest of zebrafish. We hypothesize that 8-DPAT will overcome the limitations of MBEH-induced depigmentation by targeting undifferentiated and self-regenerating stem cells. Mice treated with topical applications of MBEH and 8-DPAT were monitored for twenty-one days, scanned for depigmentation, and tissues were available and stained immunohistochemically, showing a decrease in stem cell populations in 8-DPAT treated tissues compared to MBEH. Organotypic cultures of MBEH and 8-DPAT mouse and human skin treated for 24-48 hours also showed similar results with a decrease in display of stem cell markers. Treated cultures of melanoma cell lines were counted for viable cells to determine the percentage of cell death per treatment and then analyzed with flow cytometry using antibodies to determine stem cell populations and the effects each treatment has on these populations. Compared to MBEH, 8-DPAT treated cells showed a decrease in stem cell population. The data suggests that 8-DPAT may be effective in eliminating melanoma stem cells and may contribute to an effective treatment for melanoma.

N12

Characterizing Methicillin-Resistant *Staphylococcus aureus* Isolates in a Cohort of Newborn Infants

Presenter(s)

Shannon Kurian, Illinois Mathematics and Science Academy

Monica Patel, Illinois Mathematics and Science Academy

Advisor(s)

Bill Kabat, Children's Memorial Research Center

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a bacterium resistant to beta-lactam antibiotics. Differences in MRSA types are known to distinguish between hospital-acquired and community-acquired strains. Newborn infants are at risk for certain post-natal infections such as group B *Streptococcus* and *Staphylococcus aureus*, which are acquired from the mother or the hospital setting. A cohort of fifty-four MRSA isolates from newborn infants less than 30 days old was examined. The purpose of this study was to characterize this cohort and predict whether the isolates are community-acquired or hospital-acquired based on a set of phenotypic and genotypic parameters. The following tests were performed as part of the characterization: Kirby-Bauer diffusion, polymerase chain reaction, and pulsed-field gel electrophoresis (PFGE). These tests were run to determine susceptibilities to antibiotics, specific virulence gene presence, and restriction enzyme segmentation patterns by PFGE of DNA for this cohort. The Mec-types were determined and a relational analysis was conducted as part of the determination of isolate source. Secondly, an attempt was made to determine if certain MRSA subtypes were associated with specific types of MRSA infections. Our findings suggest that the majority of MRSA isolates were community-acquired. The relationship between MRSA type and infection type was not conclusive.

N13

Using Complete Blood Count as a Marker of Neonatal Sepsis and Line Infections in Neonates

Presenter(s)

Joshua Lam, Illinois Mathematics and Science Academy

Advisor(s)

Hamzah Miltaha, Loyola University

Maliha Shareef, Loyola University

Premature newborns often require prolonged intravenous nutrition due to gastrointestinal immaturity. Central lines are utilized because they are more stable and can provide optimal nutrition. However, these lines are occasionally susceptible to infection. The purpose of this study was to investigate markers of such infections through the use of the complete blood count (CBC) prior to the positive blood culture. This is a retrospective chart review and analysis, in which patients born between January 2007 and January 2013 with central line positive blood cultures for bacteria or fungi were examined, and the CBC closest to time of central line insertion, the last before blood culture, and the closest to time of positive blood culture was taken. Eighty six patients were studied, twenty-eight patients (33%) had more than one line infected, and fifteen patients (17%) had more than one organism. Coagulase negative *Staphylococci* (CoNS) was the most common organism (54%), followed by *Enterococci* (14%) and *K. pneumoniae* (8%). Overall, this research could not prove the white blood count as a marker for culture positive central line infection. The organisms of infection identified remain consistent with previous studies, with CoNS being the most prevalent.

N14**Effects of NF- κ B Activation on E6 Oncoprotein Expression in Head and Neck Cancer Cells****Presenter(s)**

Shelly Li, Illinois Mathematics and Science Academy

Advisor(s)

Kenneth Alexander, University of Chicago

Cigarette smoking and infection with high-risk human papillomaviruses are associated with head and neck cancer. We hypothesized that cigarette smoke extract (CSE) treatment of head and neck cancer cells would increase cell invasiveness. We also hypothesized that pharmacological inhibition of E6 oncoprotein expression and NF- κ B activity would lead to decreased invasiveness and apoptosis. To determine how cigarette smoke might affect head and neck cancer cells, and to identify pharmacological agents that might be useful for the treatment or prevention of head and neck cancers, we measured the effects of CSE on the growth and invasive properties of two head and neck cell lines. We also assessed the abilities of thymoquinone, sulindac, and diclofenac to inhibit cancer cell growth and invasiveness. We found that treatment of cancer cells with CSE led to a dose-dependent increase in cell invasiveness in an invasion chamber assay. We also found, using an MTT dye assay, that thymoquinone, sulindac, and diclofenac inhibited cancer cell proliferation and led to apoptosis. These drugs also reduced cancer cell invasiveness in the invasion chamber assay. We conclude that the increased invasiveness caused by CSE can be inhibited by drugs known to inhibit E6 oncoprotein expression and NF- κ B activation.

N15**Characterizing Patents on Discoveries From Genome-Wide Association Studies****Presenter(s)**

Viveka Patel, Illinois Mathematics and Science Academy

Advisor(s)

Brandon Pierce, University of Chicago

Patents that are related to genome wide associated studies (GWAS) grant rights to use a specific genetic variant for diagnostic and risk prediction purposes. Since genetic testing may require obtaining rights from multiple patents and owners, it is expensive and difficult for one to gain the rights to develop and perform a clinical genetic test. Due to fragmented ownership, the patents could potentially have a negative impact on the cost, quality, and availability of the particular clinical genetic service. In this work, we used the United States Patent and Trademark Organization Full-Text and Image Database to identify patents that protect the rights to test genetic variants identified in GWAS. We then organized information about these patents in Excel spreadsheets, including application date, issue date, assignee, title, claims, and patent number. We found that not many GWAS patents have been issued and the companies that have been issued patents are primarily private firms, such as the Celera Corporation. Thus far, there have only been two GWAS patents issued in 2013. The patents that are being issued focus on the methods by which single nucleotide polymorphisms in the DNA can be used to diagnose a human disease. Since a relatively small number of GWAS patents are being issued, we conclude that researchers do not expect genetic tests of GWAS-identified variants to have a large clinical impact.

N16**An Analysis of the Efficacy of SPECT Scans as Both a Predictor and Measure of Change in Patients of Hyperbaric Oxygen Therapy****Presenter(s)**

Joseph Reda, Illinois Mathematics and Science Academy

Advisor(s)

August Martinucci, Midwest Hyperbaric and Wellness

Patricia Reda, Midwest Hyperbaric and Wellness

Single photon emission computed tomography (SPECT) scans are commonly used to assess the condition of patients' brains in terms of function. Often, SPECT scans are used to personalize patients' treatment regimens to best promote healthy recovery. To further understand the predictive value of SPECT scans, seven traumatic brain injury patients' SPECT scans from pre- and post-hyperbaric-oxygen-therapy (HBOT) were analyzed. The scans were quantified using Adobe Photoshop CS6. Correlation analyses were run on the data to pinpoint strong relationships between pre- and post-HBOT SPECT elements. Paired t-tests were run to quantify overall change in each patient's SPECT scans for comparison with anecdotal evidence of improvement, demonstrating SPECT scans' efficacy in assessing patient condition. No statistically significant correlations were found between pre- and post-HBOT mean values of brain perfusion; thirty-nine statistically significant correlations were found between pre- and post-HBOT standard deviations in brain perfusion. The latter are impractical for prediction because they primarily predict global changes in the brain, rather than improvement or remission. All seven patients showed a statistically significant change in overall perfusion. Changes in perfusion with larger magnitude identified more closely with previous observations than changes in perfusion with smaller magnitudes.

N17**Effectiveness of Commonly Used Medical Smartphone Applications in Correctly Diagnosing Diseases****Presenter(s)**

Sankeerth Reddy, Illinois Mathematics and Science Academy

Sunny Shah, Illinois Mathematics and Science Academy

Advisor(s)

Susan Styer, Illinois Mathematics and Science Academy

Recently, the use of medical applications on smartphones has gained popularity among people who wish to self-diagnose their symptoms instead of visiting a doctor. The purpose of our investigation was to test how accurately these medical applications are able to diagnose a patient when provided with that patient's symptoms. We used the Mayo Clinic disease and conditions website as a standard to find the symptoms of twenty-eight diseases of neural, blood, or tissue origin. Then, we chose three applications, WebMD, Health Tab, and Itriage, and entered the symptoms in each application for each disease. Each application provided a list of potential diseases in order of likelihood. We recorded whether the application reported the correct disease to be first in the list, second, or neither. The Friedman test on two way analysis of ranks, showed(s) that the Itriage application had a better rating of approximately 0.29 higher than the other two applications. However, when Itriage was compared to the Mayo Clinic website, Itriage rated 1 rank lower. We concluded that the three applications were not significantly different from one another, however they were all significantly less accurate than the Mayo Clinic website.

N18**Using Task Shifting as a Model to Improve Injury and Trauma Care in Sub-Saharan Africa****Presenter(s)**

Hannah Sambor, Illinois Mathematics and Science Academy

Advisor(s)

Stacey Chamberlain, University of Illinois at Chicago

Task shifting, teaching lower level health care providers advanced tasks, is used in resource-limited settings with few numbers of physicians. This investigation examines how task shifting can be used as a feasible model to improve injury and trauma care in Sub-Saharan Africa. This study is a review of medical databases to gain information about the overall burden of injury and trauma care in low income countries, and the prevalence of pediatric injuries. In central Sub-Saharan Africa, road traffic injuries have increased from 1990-2010 as a cause of death by 53%; drowning has increased by 54%, and deaths by fire have increased by 47%. Trauma and injury to children is increasing because of the expansion of roads without safety education, urbanization, violence, and the lack of health education. Task shifting has been successfully used in other health care disciplines, such as in HIV/AIDS treatment. For example, a study in Cameroon showed no statistically significant differences in disease progression or mortality when antiretroviral treatment was given by a nurse or physician. Further studies are needed to find out if a task shifting model can be effectively implemented to improve the standard of care for trauma and injury patients in Sub-Saharan Africa.

N19**Correlation of Gestational Age and Independent Oral Feeding in Preterm Newborns****Presenter(s)**

Frances Seo, Illinois Mathematics and Science Academy

Advisor(s)

Jonathan Muraskas, Loyola University
Sarah Van Nostrand, Loyola University

Preterm newborns fully coordinate the ability to suck, swallow, and breathe as they approach their due date (forty 0/7 weeks). They are fed through a nasogastric tube that extends from the nose to the stomach before the development of independent oral feeding, which is a major milestone that allows discharge with parents. Knowing the mean gestational age (GA) of complete maturation of this innate reflex will help medical practitioners predict the discharge date. Variables such as gender, ethnicity, and delivery route were tested. The study consisted of 1,097 preterm newborns in a single neonatal intensive care unit from 1978-2001. Subjects were excluded if they were discharged home on tube-feeding, had a congenital anomaly, or required significant resuscitation at birth. Fischer t-test and ANOVA Tukey HSD test were used for statistical analysis. The mean GA when preterm newborns could independently feed orally was thirty-six 5/7 weeks. There was no statistical evidence that gender or race affected the development of independent oral feeding. Those delivered by Caesarian section compared to those delivered vaginally had a significant delay in the maturation of this reflex. We conclude preterm newborns independently oral feed (breast/bottle) approximately three weeks before their due dates regardless of gender or ethnicity.

N20

A Prospective Outcome of Condensed Polytetrafluoroethylene Mesh in Non-Sterile Abdominal Wall Defects

Presenter(s)

Ross Skelly, Illinois Mathematics and Science Academy

Advisor(s)

Jing Liu, Northwestern University

Abdominal surgery requires the opening and subsequent closure of the abdominal wall, and this closure is never as strong as the original. Local areas of weakness in the abdominal wall are highly susceptible to the formation of incisional abdominal hernias. Thus, abdominal surgery requires an auxiliary agent for closure. Our goal was to determine if a polytetrafluoroethylene (PTFE) meshes such as MotifMESH may reduce recurrence issues associated with incisional abdominal hernias. We performed a case study on ten subjects who underwent incisional abdominal hernia repair using MotifMESH. Each subject was monitored for signs of recurrence and infection through periodic check-up visits for 360 days following surgery. At each visit, subjects indicated the pain associated with their repair on a Visual Analogue Scale (VAS). They also completed quality of life questionnaires at the beginning and end of the study. Though the case study is not completed, only one subject has experienced an infection and recurrence issue. From day 1 to day 360, VAS scores decreased by an average of 17.44 points while overall quality of life increased by 1.25 points. Preliminary data indicate that using a condensed PTFE mesh may be useful and effective in incisional abdominal hernia repair. Thus, a larger study to determine this significance may be warranted.

N21

The Experience of *GATA6* Mutations of All Subjects in the Monogenic Diabetes Registry

Presenter(s)

Sai Talluru, Illinois Mathematics and Science Academy

Advisor(s)

Graeme Bell, University of Chicago

David Carmody, University of Chicago

Siri Atma Greeley, University of Chicago

This investigation intended to identify cases of *GATA6* in the Monogenic Diabetes Registry; study the clinical, phenotypical, and genetic implications in affected patients; and identify any novel mutations. Monogenic forms of diabetes are caused by single gene defects. The vast majority of patients with neonatal diabetes mellitus diagnosed before the first six months of life are found to have an underlying monogenic cause. *GATA6* is a highly conserved transcription factor that is expressed in the pancreas, heart, gallbladder, and gut tissues. From over sixteen-hundred registry participants, twenty-four were selected for study based on a diagnosis of diabetes within the first two months of life. Saliva-derived DNA was isolated and sequenced to identify causal variants within the gene. Two patients were identified with *GATA6* mutations. Their clinical and genetic data was compiled to establish the typical features associated with this rare genetic mutation. Our data demonstrated that the high frequency of cardiac defects, intra-uterine growth, neurodevelopmental delay, and digestive tract malformations are characteristic of *GATA6* mutations. Physicians should consider screening for *GATA6* mutations in infants diagnosed with neonatal diabetes mellitus and any one of the other typical features.

N22

Discovering New Chemokine Agonist Receptor Drugs

Presenter(s)

Shruti Topudurti, Illinois Mathematics and Science Academy
Selam Zenebe-Gete, Illinois Mathematics and Science Academy

Advisor(s)

Richard Miller, Northwestern University
Andrew Shum, Northwestern University

CXCR4 is the chemokine receptor which aids in chemotaxis of stem cells, such as those in the bone marrow or the brain. SDF-1 is the natural ligand for the CXCR4 receptor. Similarities between novel molecule 390 and SDF-1 make the novel small molecule a possible agonist of the CXCR4 receptor. 390 is the first small molecule agonist of CXCR4 receptors ever identified and may have a number of uses in medicine. To determine whether 390 is an agonist to the CXCR4 receptor, we transfected cells with CXCR4 and exposed them to a negative control, SDF-1, or 10 μ M, 1 μ M, .1 μ M, and .01 μ M of our agonist drug. Next, we took calcium images using the dye fura-52, which indicates an increase of calcium in the cell resulting from the activation of CXCR4. There was an increase in calcium in the cells, indicating that the receptor was being activated. When compared to the natural ligand, SDF-1, the levels were not as high, but were higher than the vehicle control. In the internalization assay, a second way of assessing agonist effects on receptors, both SDF-1 and 390 internalized the receptor causing it to leave the cell membrane and enter the cell. The results suggest 390 is an agonist or partial agonist of the CXCR4 receptor.

O01

Changes in Hippocampal Volume Between Patients With Alzheimer's Disease and Other Cognitive States

Presenter(s)

Ashok Arjunakani, Illinois Mathematics and Science Academy

Advisor(s)

Lei Wang, Northwestern University

Alzheimer's disease (AD) is a progressive form of dementia that inhibits memory, thinking skills, and a person's ability to do simple tasks. AD is closely linked to the hippocampus and it has similarities to other diseases such as mild cognitive impairment (MCI). In this investigation, hippocampal volumes and hippocampal subfield volumes of patients with AD, progressive MCI, stable MCI, cognitively normal control, and preclinical normal control were compared to look for significant differences. Magnetic resonance imaging (MRI) scans were collected from 442 subjects. Then a principal component analysis was run through MATLAB© in order to condense the data points from many to a few. With this condensed data, hippocampal maps were created to compare patients. A multivariate analysis of variance (MANOVA) was used to look for significant differences in the overall hippocampus and in its subfields. Similar results were obtained from both the subfields and the overall hippocampus. It was found that the controls and the stable MCI groups were not significantly different from each other. The AD group was significantly different than the others, having the least hippocampal volume. This data shows the similarity between AD and MCI and a serious degradation of the hippocampus in these diseases.

O02**Acoustical and Optical Amplitude Modulated Signals in the Inferior Colliculus of the Midbrain****Presenter(s)**

Gary Chen, Illinois Mathematics and Science Academy
Dipen Kumar, Illinois Mathematics and Science Academy

Advisor(s)

Claus-Peter Richter, Northwestern University

The inferior colliculus (IC) of the midbrain is known to organize auditory sensory information. Our study is concerned with determining how exactly it organizes optical amplitude modulated signals versus the conventional acoustic amplitude modulated signals. The goal is towards creating a better near infrared stimulated cochlear implant to replace the standard electrical one since focal stimulation is not possible resulting in reduced tone recognition and range. For our study, guinea pigs were subjected to deafening and their hearing was tested before and after the deafening using both acoustical and laser stimuli. We measured their responses to these stimuli and recorded them using a 16 channel electrode which was placed in IC. By locating the time of the responses, we aim to compare the hearing ability of the deafened animal and the normal one. This way we can understand the organization of how optical and acoustical information is organized in the IC. Currently, we are taking the data and running it through a MATLAB program to create histograms that show at what amplitude and time action potentials take place in the IC.

O03**The Effect of Early Maternal Care on Recovery From Febrile Seizures in *Cx3cr1^{GFP}* Mice Pups****Presenter(s)**

Kathleen Chinetti, Illinois Mathematics and Science Academy

Advisor(s)

Sookyong Koh, Children's Memorial Research Center

This investigation studies the relationship between early rearing environment and post-seizure recovery in mice pups, but first an accurate mouse model of parental neglect needed to be developed. Beginning two days after birth, pups underwent either three-hour (MD) or fifteen-minute maternal separation daily. Fourteen days after birth (P14), seizures were induced using bacterial endotoxin lipopolysaccharides (LPS) followed by hyperthermia as a model for febrile seizures. Using this model, quality of maternal care was reduced in the MD litters, as shown by decreased maternal grooming time ($p < 0.04$). This inferior maternal care affected pups' development, including weight gain. MD pups had significantly lower weights on P14 than their MD counterparts ($p < 0.005$). They had increased seizure susceptibility as reflected by lower threshold temperature ($p < 0.03$). These results establish the current mouse model of maternal deprivation as reliable and accurate, allowing for future experiments regarding post-seizure recovery. We will use *Cx3cr1^{GFP}* mice whose brain immune cells microglia are labeled with green fluorescent protein to quantify febrile seizure-induced activation of immunity and compare between pups reared in different environment. We propose to test the hypothesis that maternal deprivation not only make pups more vulnerable to seizure, but also delay their recovery from seizure-induced neuro-inflammation.

O04

Partial Recollection as a Unique Memory Type and Corresponding Brain Activity

Presenter(s)

Anastasia Fafara, Illinois Mathematics and Science Academy
Brianna Pusey, Illinois Mathematics and Science Academy

Advisor(s)

Joel Voss, Northwestern University

Partial recollection memory occurs when a person attempts to recall information, like the capital of a country, but instead only recalls a fragment of information (For example, first/last letter, number of syllables, and so forth). This kind of memory failure happens to those with brain damage or neurological diseases as well as healthy individuals, but little is known about how or why. This study explores mechanisms of partial recollection by identifying corresponding brain activity. An experiment was designed to evoke partial recollection in the laboratory while simultaneously measuring brain activity with an electroencephalograph (EEG). During the study phase, subjects read one-hundred and thirty-five words that were answers to general knowledge questions (for example, pancreas) while EEG data were recorded. Later subjects responded to the corresponding questions (for example, What organ produces insulin?). Their answers were then placed into the following categories: (1) correct, for a correct answer, (2) incorrect, for a completely wrong or absent answer, and (3) partial recollection. In a sample of healthy young adults (N=11), partial recollection occurred for approximately 9% [T(10)=8.64, P=<0.0001] of all questions. The comparison of incorrect, correct, and partial EEG data suggested that partial differs from full recollection, which implies that each condition is distinct. This information may deepen understanding of memory problems.

O05

Investigating the Effects of *ALS2* and *SOD1* in the Upper Motor Neurons

Presenter(s)

Kent Gang, Illinois Mathematics and Science Academy
Deborah Park, Illinois Mathematics and Science Academy

Advisor(s)

Pembe Hande Ozdinler, Northwestern University

The mechanisms behind amyotrophic lateral sclerosis have yet to be understood clearly. Several genes linked to the disease such as the Cu/Zn-superoxide-dismutase-1 (*SOD1*) and *alsin* genes suggest mechanisms for upper motor neuron death. In order to study the effects of these genes, immunohistochemistry was used on sections of *SOD1* mutant and *alsin* knockout mice to detect neuronal markers. Our work involved the identification of mutant mice through DNA purification and polymerase chain reaction as well as creating neuronal tissue stains and interpreting its meaning. Dissection and confocal microscopy were two other skills needed to gather data from genetically altered mice. We were able to use the finished stains of mice at different time points to draw support for the crucial involvement of upper motor neurons. This is directly in line with research in this field, which is attempting to clarify how certain genes mediate neuron death.

O06

Exploring Brain Mechanisms Underlying Aversion to Nicotine

Presenter(s)

Stephanie Hatz, Illinois Mathematics and Science Academy

Advisor(s)

Daniel McGehee, University of Chicago

Shannon Wolfman, University of Chicago

Smoking tobacco is a leading cause of death and disease worldwide. The addictive properties of nicotine, its addictive component, depend upon enhanced dopamine release in ventral tegmental area. High doses can cause avoidance of nicotine, however, which has been seen in behavioral experiments as condition placement aversion. It is unclear what brain regions mediate aversion, but studies show interpeduncular nucleus (IPN) is involved. It is hypothesized that high doses limit consumption by activating IPN, which inhibits laterodorsal tegmentum (LDTg) and firing of dopamine neurons. Retrograde labeling dye was injected bilaterally into LDTg to identify IPN neurons that project there. Immunohistochemistry was done to confirm injection, but was unsuccessful due to failure of the dye to inject or incorrect stereotaxic coordinates. Immunolabeling was done for excitatory amino acid transporter-3 (EAAT-3) to determine the presence of glutamatergic neurons, suggesting excitatory projection from IPN to LDTg. The results suggest presence of glutamatergic neurons in IPN. Because evidence shows other cell types may also express EAAT-3, however, the results are inconclusive. Immunolabeling was done for gamma-aminobutyric acid (GABA) to determine presence of GABAergic neurons in IPN, suggesting inhibitory projection from IPN to LDTg. No GABA labeling was observed in the brain, suggesting ineffective immunohistochemistry protocol. More experiments must be done to determine if GABA is present in IPN.

O07

Presenter(s)

Kevin Hong, Illinois Mathematics and Science Academy

Matthew Park, Illinois Mathematics and Science Academy

Advisor(s)

Dan Nicholson, Rush University Medical Center

Alzheimer's disease (AD) is the most common form of dementia. It is characterized by the build-up of amyloid plaques in the brain that damage synapses and result in memory loss and impaired motor skills. Furthermore, a sub-population of AD patients experience visual symptoms such as macular degeneration. This investigation looked at how AD affected ribbon synapses in the eyes of mouse disease models. A ribbon synapse is vital for vision because it allows for the extremely fast communication between retinal neurons. AD mice and wild type mice eyes were fixed, and an electron microscope was used to image the dSR regions of the mouse eyes. These images were stacked to create three-dimensional representations of the eye. In these models, we used the scale of the microscope slides to measure the lengths of the ribbon synapses in relation to the neurons the synapses originated from. Differences in ribbon synapses between the eyes of disease and wild type mice would indicate that AD affects vision by targeting the ribbon synapses in the eye.

O08

Achieving Hippocampus Activation Through fMRI Tests

Presenter(s)

Shreya Jain, Illinois Mathematics and Science Academy
Anna Kryczka, Illinois Mathematics and Science Academy

Advisor(s)

Todd Parrish, Northwestern University

The hippocampus is a structure located within the temporal lobe of the brain which plays a role in memory. Using functional magnetic resonance imaging (fMRI) it is possible to map areas of activation within the hippocampus of a subject engaged in a memory task. The activation patterns could be used as a way to predict the post-surgery memory deficit in patients who are planning to have brain abnormalities removed. Such an fMRI scan could replace more invasive techniques such as the Wada test. We created memory tasks which required subjects to go through the three stages of memory: encoding, storage, and retrieval. The subjects were placed inside an fMRI machine where they engaged in multiple memory tasks: a four part visual and verbal task, an emotional memory task, and a scenic memory task. The visual and verbal memory task had the most hippocampus activation when compared to others. The visual task displayed 97% activation in the left hippocampus and 87% in the right hippocampus. However, each task activated the hippocampus minimally in all subjects. In addition, patients with lower accuracy scores had higher activation levels. We concluded that our tasks have the potential to be used clinically.

O09

The Circadian and Melatonin-Dependent Regulation of *e4bp4* mRNA Expression in Siberian Hamsters (*Phodopus sungorus*)

Presenter(s)

Omkar Kelkar, Illinois Mathematics and Science Academy

Advisor(s)

Kenneth Onishi, University of Chicago
Brian Prendergast, University of Chicago
Tyler Stevenson, University of Chicago

Circadian rhythms are controlled by a hypothalamic region referred to as the suprachiasmatic nucleus, the output of which is regulated by secretion of pineal gland melatonin. The present study employed invasive or non-invasive methods to examine *e4bp4* mRNA expression in male Siberian hamsters. First, I examined circadian expression of *e4bp4* expression in the hypothalamus and established that *e4bp4* expression is low during the subjective day and peaks prior to lights off (16L:8D). To examine the role of melatonin signalling in circadian *e4bp4* expression, hamsters were rendered arrhythmic by either pinealectomy (PINx) or disrupted phase shift (DPS) methods. *E4bp4* expression was measured one hour after lights on (zt1) or zt13 and compared to sham-operated hamsters. In both studies, *bmal1* and *per1* expression, known circadian genes, were studied for comparison. The data show that both DPS and PINx are sufficient to disrupt *e4bp4* circadian expression. Specifically, PINx and DPS eliminated peak *e4bp4* expression at zt13 whereas sham-operated hamsters maintained circadian rhythmicity. The findings are the first to demonstrate melatonin regulation of circadian *e4bp4* expression. These data provide the foundation for functional studies that assess the role of *e4bp4* expression in dictating circadian responses in physiology and behavior.

O10

The Effect of Combined Donepezil and Memantine Treatment on Hippocampal Subiculum and CA1 in Alzheimer's Disease Patients

Presenter(s)

Omkar Kelkar, Illinois Mathematics and Science Academy

Amy Zhu, Illinois Mathematics and Science Academy

Advisor(s)

Lei Wang, Northwestern University

Previous research indicates that Alzheimer's disease (AD) neuropathology is marked by substantial volume loss in the hippocampal subregions subiculum and CA1. In application, singular treatment of donepezil has not demonstrated significant reduction of rate of hippocampal structural deterioration when compared with patients who did not receive treatment. Subsequently, the present study will examine the combined treatment of donepezil and memantine, another commonly used AD treatment, on the rates of deterioration in hippocampal subfields. To conduct this experiment, principal component analysis was first used across longitudinal hippocampal surface data to obtain measures of shape change over time. Then, ANOVA was performed to compare the four sample groups: control, untreated, donepezil, and combined. The results of the study show that amongst all samples, regardless of treatment, there is no significant difference in longitudinal shape deterioration in subiculum or CA1 subfields. Although the data of some principal components in subiculum under dual treatment display significant reduction of deformation when compared with other treatment patterns, the majority of the principal components in both subiculum and CA1 demonstrate no significant change. Accordingly, since the trend suggests insignificant difference, the results conclude that combined treatment is insufficient to reduce neuropathology of Alzheimer's disease versus single or no treatment.

O11**Identifying the Target Genes of TDP-43 Regulated miRNAs and Their Correlation With Neurodegeneration****Presenter(s)**

Nishita Kumar, Illinois Mathematics and Science Academy
Jackson Michuda, Illinois Mathematics and Science Academy

Advisor(s)

Jane Wu, Northwestern University

RNA binding proteins (RBPs) affect post-transcriptional gene regulation. TAR DNA-binding protein 43 (TDP-43) is a RBP that regulates microRNAs (miRNAs). A pathologic, mutated version of the protein is associated with neurodegeneration, specifically frontotemporal lobar degeneration (FTLD), due to regulation of abnormal miRNA. Three miRNAs have been found to be regulated by TDP-43: miR-143, miR-500, and miR-574. The purpose of this investigation is to find the target genes regulated by these three miRNAs. The potential sites were identified using bioinformatics, and then confirmed experimentally. To do this, the miRNA target site predictors, DIANA, Pictar, and Targetscan, were used. Results were filtered to only contain mRNA of genes associated with neuronal development and degeneration. To confirm the target gene, the miRNA's ability to influence its consequent protein and the function of that protein, was tested. The primer for the target genes was identified, and then a 3' UTR-luciferase plasmid was created. A luciferase assay was run, to confirm the target genes. Significant results are contingent upon further testing that will occur in the coming weeks. Identifying potential target sites of relevant miRNA furthers understanding of FTLD and neurodegeneration.

O12

Progressive Interactions Between Amyotrophic Lateral Sclerosis-Related FUS Mutant and Protein Chaperones

Presenter(s)

Lakhena Leang, Illinois Mathematics and Science Academy
Xueyang Ren, Illinois Mathematics and Science Academy

Advisor(s)

Richard Morimoto, Northwestern University
Anan Yu, Northwestern University

Fused-in-sarcoma (FUS) protein has been linked to motor neuron apoptosis in the neurodegenerative disease amyotrophic lateral sclerosis (ALS). Mutant variations of FUS proteins have been observed to lose solubility and form aggregates in the cytoplasm. Molecular chaperone Hsc70 is important in preventing protein misfolding and is known to be recruited to protein aggregation. A progressive loss of free Hsc70 due to aggregate sequestration is proposed as a cause for the phenotypic complexity of diseases of protein misfolding. We aim to observe the interactions of wild type and mutant FUS with chaperones in human prostate cells, and the mechanisms by which these interactions affect cellular functions mediated by Hsc70. First, plasmids containing mutated and wild type FUS genes were created, cloned, and confirmed by sequencing. Genes were expressed through transient expression by transfecting the cloned plasmid into PC-3 cells and observing their expression and subcellular localization using an epifluorescent microscope. Western blots of the cells confirmed expression of the protein at the correct molecular weight. Results show that the R521G-FUS protein mutation had the greatest effect on the PC-3 cells. Findings support studies that correlate FUS mutations with ALS. This may help determine mutations of ALS proteins that are potential molecular targets for therapy.

O13

Differences Between the Inhibition of Cholinesterase and Acetylcholinesterase

Presenter(s)

Jessica Lee, Illinois Mathematics and Science Academy

Advisor(s)

Changiz Geula, Northwestern University

The purpose of this research was to test for a biomarker that could lead to early diagnosis of Alzheimer's disease (AD) in living patients. This investigation was conducted using cholinesterase (ChE) activity in plasma. Plaques and tangles, the pathological hallmarks of AD, contain the ChEs acetylcholinesterase (AChE) and butyrylcholinesterase (BuChE) activities. It has been shown that unlike ChEs in normal neurons and axons, AChE and BuChE in plaques and tangles are inhibited by indoleamines, and protease inhibitors. We investigated the presence of differences between the inhibition of AChE and BuChE by the indoleamine serotonin (5-HT) and the protease inhibitor bacitracin in AD plasma when compared with normal plasma. Parallel inhibition assays were conducted with pairs of normal and AD plasma. We tested twelve such pairs of plasma for levels of inhibitable AChE and BuChE activities. Our preliminary observations indicate significantly lower 5-HT and bacitracin inhibitable AChE and BuChE activities in AD plasma when compared with normal plasma. These results suggest that inhibitable plasma AChE and BuChE may allow diagnosis of AD perhaps in its early stages, which would then make possible for treatment to start early in the disease course.

O14

Analysis of Glial Activation in R6/2-YFP Mice: A Novel Mouse Model for the Analysis of Axonal Degeneration

Presenter(s)

Judy Li, Illinois Mathematics and Science Academy

Advisor(s)

Rodolfo Gatto, University of Illinois at Chicago

Gerardo Morfini, University of Illinois at Chicago

Huntington's disease (HD) is a neurodegenerative genetic disorder resulting from expansion of a polyglutamine tract in the protein huntingtin (Htt). We evaluated whether alterations in glial cell activity correlated with axonal degeneration. Immunohistochemistry techniques using well characterized markers of glial activation were applied to a novel transgenic model of HD (YFP-R6/2) and control (YFP) mice. Nine animals per group were analyzed at 30, 60, and 90 days of age. Antibodies recognizing myelin basic protein (MBP) and 2', 3'-cyclic nucleotide 3'-phosphodiesterase (CNPase) were used to evaluate oligodendrocyte activity, whereas an antibody against glial fibrillary acidic proteins (GFAP) was used to evaluate astrocyte activation. Quantitative fluorescence imaging showed a significant decrement in MBP immunoreactivity at 60 days of age ($p < 0.05$), as well as increased CNPase levels at 90 days ($p < 0.001$) of age in YFP-R6/2 mice, compared to YFP mice. Intriguingly, GFAP levels were significantly higher in YFP-R6/2 mice than YFP mice at 30 days of age ($p < 0.05$), but lower at 90 days ($p < 0.001$). Results from our studies suggest that mutant Htt expression affects glial cells in two different temporal patterns; an initial phase characterized by increased astrocytic response, and a late phase featuring oligodendrocyte activation and myelin deterioration. Taking in consideration our previous work, results here suggest that glial activation represents a response, rather than a cause of axonal degeneration in HD.

O15

Developing Therapeutic Approaches to Neurodegenerative Diseases Associated With Defects in RNA-Binding Proteins

Presenter(s)

Emily Ling, Illinois Mathematics and Science Academy

Hye Jean Yoon, Illinois Mathematics and Science Academy

Advisor(s)

Jane Wu, Northwestern University

The purpose of this investigation was to study mitochondrial protectors as potential therapies for amyotrophic lateral sclerosis (ALS) and other neurodegenerative diseases associated with mutations in the RNA-binding proteins, fused in sarcoma/translated in liposarcoma (FUS) and TAR DNA-binding protein of 43 kDA (TDP-43). For ease of observation, this investigation used transgenic *Drosophila* expressing mutant FUS and TDP-43 proteins in the ommatidia of the eye. Flies were treated with food containing 5 and 10 μM of the compounds necrostatin-1, N-acetylcysteine (NAC), guanabenz (GBZ), and tacrine. The eye phenotype was observed at regular intervals using a set of criteria evaluating level of degeneration. Tacrine and necrostatin-1 were toxic to larvae, but the other two drug treatments affected disease progression. Compared to the control, NAC and GBZ significantly improved the pupae formation, eclosion, and survival rates of the transgenic flies. In flies expressing mutant FUS proteins, NAC improved the eye phenotype compared to GBZ ($p < 0.05$). Flies treated with 10 μM of NAC or GBZ often showed more severe eye phenotypes than those treated with 5 μM , suggesting that excessive dosages may worsen symptoms. Although further investigation is needed, NAC and GBZ may be potential therapies for ALS and related diseases.

O16**Role of Mutant SOD1 Molecules as Membrane Active Elements in Amyotrophic Lateral Sclerosis Pathology****Presenter(s)**

Sarah Martin, Illinois Mathematics and Science Academy

Advisor(s)

Michael Allen, University of Chicago

Ana Correa, University of Chicago

Amyotrophic lateral sclerosis (ALS) is a fatal motor neuron disease, characterized by the degeneration of motor neurons in the brain stem and spinal cord. While 90% of ALS cases are sporadic, approximately 10% are familial. A portion of familial cases are attributed to genetic mutations, the most common being those in the copper-zinc superoxide dismutase 1 (SOD1). How do SOD1 molecules contribute to cell degeneration in ALS? One hypothesis is that defective SOD1 molecules incorporate in the plasma membrane making it more permeable to ions. Increased internal calcium would promote apoptosis. To test this hypothesis, RNA samples encoding for the human SOD1, both native and mutant, were microinjected into *Xenopus laevis* oocytes. Protein expression was followed by monitoring the levels of Venus, a fluorescent label co-transcribed with the SOD1 RNA. To measure the incorporation of the proteins, the voltage across the oocyte membrane was measured, using a glass microelectrode coupled to a voltmeter. Preliminary analysis indicates that there is no direct correlation between the membrane voltage and fluorescence. There may be a small difference between the oocytes expressing native SOD1 and the oocytes expressing mutant channels. These results suggest that the mutant SOD1 molecules are not incorporating in the oocyte membrane.

O17**Expression and Detection of the Ion Channel GABA_A Receptor Subunits α 1 and γ 2 in HEK293 Cells****Presenter(s)**

Shivani Patel, Illinois Mathematics and Science Academy

Advisor(s)

Kaouther Ajroud, Northwestern University

Dane Chetkovich, Northwestern University

The GABA_A (gamma aminobutyric acid) receptor is a ligand gated ion channel consisting of multiple subunits that is major postsynaptic receptor for GABA, a brain neurotransmitter. Mutations in GABA_A receptors have been implicated in neurological diseases, such as schizophrenia and epilepsy. Recent studies suggested that these mutations alter receptor biogenesis, function, and trafficking which may lead to abnormal antibody formation against the mutated receptor subunits in patients that exacerbate the disease. The aim of the current study is to develop a tool to detect GABA_A receptor autoantibodies. We generated stable HEK293 cell lines individually expressing GABA_A receptor subunits α 1 and γ 2 and conducted immunohistochemistry analysis in order to compare and evaluate which expression method will allow better detection of the autoantibodies. The stable cell lines individually expressing GABA_A α 1 and γ 2 subunits showed strong reactivity to commercial antibodies raised respectively against α 1 and γ 2 subunits. Thus, our result will allow us to use these stable cell lines as a qualitative tool to detect the possible presence of GABA_A autoantibodies in patients' serum.

O18**Poor Sleep Quality in the Elderly and How it Affects Cognitive Functioning****Presenter(s)**

Yvette Ramirez, Illinois Mathematics and Science Academy
Michelle Wiebe, Illinois Mathematics and Science Academy

Advisor(s)

Kathryn Reid, Northwestern University

Aging is associated with a high prevalence of sleep disturbances, resulting in poor sleep in many elderly adults. Since sleep is necessary for proper functioning of the cerebrum (the part of the brain responsible for cognitive functioning), this investigation aimed to find a relationship between poor sleep quality in the elderly and their cognitive performance. To assess the extent of the effect of poor sleep on cognition, the Automated Neuropsychological Assessment Metrics (ANAM) scores and Pittsburgh Sleep Quality Index (PSQI) global scores were compared. From the various tests on the ANAM battery, the mathematical processing and continuous memory tests were chosen as the two tests to be analyzed. The subjects were split into good (PSQI score less than 5) and bad (PSQI score greater than or equal to 5) sleepers. According to a t-test, there was no significant relationship between sleep quality and cognition. The mean of the number correct on the math test for good sleepers is 19.2 and 18.9 for bad sleepers. We may have been unable to detect a difference between groups because we did not control for other factors influencing cognitive performance like gender and age.

O19**The Effect of Cortical Thickness, Hippocampal Subfield Measures, and Hippocampal Volume on the Discrimination Power of Alzheimer's Disease Patients****Presenter(s)**

Vignesh Ravi, Illinois Mathematics and Science Academy

Advisor(s)

Lei Wang, Northwestern University

Previous research has shown hippocampal volume to be the most accurate biomarker for Alzheimer's disease (AD) patients. The goal of this research is to determine whether the use of hippocampal subfield measures, including cortical thickness measures, will increase our ability to discriminate dementia of the Alzheimer's type from cognitively normal individuals. The methods utilized in this project were principal components analysis, shell programming, and SPSS. Shell programming was used to navigate to and edit scripts that managed the data, principal components analysis was used to develop measures on which an ANOVA could be conducted, and SPSS is being used to analyze the data and draw correlations between the factors and discrimination power. An ANOVA was used to examine differences between cNC (control), prMCI (progressive MCI), stMCI (stable MCI), and AD patients. No significant difference was found between the cNC and pNC, which shows that patients whose conditions were not worsening did not encounter further hippocampal degradation. This research will help improve the likeliness of diagnosis of Alzheimer's disease in patients and aid in preventative measures. It will affect the lives of those who have or know someone with this disease by being cautious about the outcomes.

O20**How Concrete and Abstract Words are Processed With Different Magnitudes Within the Brain****Presenter(s)**

Devin Scott, Illinois Mathematics and Science Academy
Jennifer Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Vernon Leo Towle, University of Chicago

Our investigation focused on how concrete and abstract words are processed by examining their respective magnitudes in the gamma frequency power spectrum (70-100 Hz). A computer program was utilized to analyze electroencephalograph (EEG) data from six epileptic patients through electrocorticography (ECoG). Ten concrete and ten abstract words, which were categorized based on stimulus and word type, were given verbally or visually to each patient. Patients were asked to study the words before a cued recognition task while the electrodes monitored their EEG oscillations. In three patients, we determined a significant difference between the concrete and abstract magnitudes taken at the highest peak of the gamma power spectrums within a predetermined time interval. We hypothesized that the EEGs would show a higher activation in abstract words and T-tests indicated that the abstract word amplitudes were statistically higher than the concrete word amplitudes in both auditory and visual stimuli in the frontal and temporal lobes. This supports previous studies that found higher brain activity for abstract words in the frontal lobe, suggesting a difference in the pathways of word storage in the brain.

O21**Effects of Visualization on Long Term Memory in Epileptic Patients****Presenter(s)**

Carrie Sha, Illinois Mathematics and Science Academy

Advisor(s)

Vernon Leo Towle, University of Chicago

The ability to visualize images has been previously demonstrated to be a crucial element of memory retention and free recall. However, changes to the visualization pathway in epileptic patients are largely unknown. Six postoperative epilepsy surgery patients were given a long-term memory test to compare their ability to recognize and freely recall abstract and concrete nouns. During these tasks, the electrical brain activity of the patients was monitored through electrocorticography and brain activations were studied in the gamma band (70-100 Hz). The latency of the patients' response was measured and their gamma activations were mapped to cortical areas. Memory activation in the temporal lobe was shown to have a greater latency for abstract as opposed to concrete nouns. The magnitude of gamma activation during cued recognition was 16.21733 μV^2 higher for abstract nouns than for concrete nouns. The increased activation for abstract nouns was recorded in both the frontal and temporal lobes for three out of six patients, suggesting that visualization pathways are widespread in the brain. Further studies could include studying the association of particular nouns with actions as a memorization mnemonic strategy for patients. Understanding visualization pathways in epileptic patients may help increase techniques for memory retrieval.

O22

Biochemical Studies of Estrogen Receptor Protein Interactions in the Hippocampus of Rats

Presenter(s)

Medha Singh, Illinois Mathematics and Science Academy
Lynette To, Illinois Mathematics and Science Academy

Advisor(s)

Nino Tabatadze, Northwestern University
Catherine Woolley, Northwestern University

Estradiol (E2), locally synthesized in the brain, stimulates estrogen receptor alpha (ER α) and beta. Studies have shown that the increase in E2 levels suppresses inhibitory synaptic transmissions in the hippocampus of rats. This study focused on the ER α and other estrogen receptor protein interactions that occur prior to the suppression of inhibitory synaptic transmissions. After homogenizing hippocampal regions of rats and obtaining membrane fractions, three Western blots were run to visualize the presence of ER α and the G protein coupled metabotropic glutamate receptor (mGluR1) and inositol trisphosphate receptor (IP3R). Then two co-immunoprecipitations were run on the samples using mGluR1 antibody to determine the interactions between [ER- α and mGluR1] and [mGluR1 and IPR3] using Western blots. Results showed that some ER α and some IP3R were attached to mGluR1, proving that ER α , mGluR1, and IP3R interact with each other in rat hippocampus. Our study can be further extended by treating samples with E2 and determining how the interactions are modulated by focusing on downstream molecular targets that may potentially lead to the suppression of inhibitory synaptic transmission in the hippocampus. Also, since high E2 levels have been shown to enhance seizures in epileptic individuals, more efficient anticonvulsant therapy can be found.

O23

Audio-Tactile Interactions in Texture Perception in Humans

Presenter(s)

Vimig Socrates, Illinois Mathematics and Science Academy

Advisor(s)

Sliman Bensmaia, University of Chicago

Mechanical oscillations in the environment convey information about objects and events and are transduced by specialized receptors in the ear or the skin. Importantly, stimulation of the ear drum and of the skin often happen together and conveys redundant sensory information. The nervous system can thus integrate information from these two sensory modalities to obtain a more robust percept. In the present study, we explore the interactions between touch and hearing in the perception of surface texture. Specifically, we have subjects feel textured surfaces and perform perceptual judgments about them while manipulating the auditory feedback that they receive. Specifically, we record the sounds made during the exploration of texture using a small microphone attached to the finger, then replay these vibrations through earphones. We can then manipulate the frequency composition of this feedback (by putting it through a filter) and assess the effects of these manipulations on the tactile perception of texture. We find that certain distortions of the auditory feedback actually change the way textures feel. We explore different putative neuronal mechanisms that may underlie this audio-tactile interaction.

O24

Combinatorial Preconditioning of a Neuronal Cell Line With Low Ethanol and Resveratrol to Achieve Neuroprotective Upregulation of Focal Adhesion Kinase and its Phosphorylated Form

Presenter(s)

Saigopal Somasundaram, Illinois Mathematics and Science Academy
Sarah Valentine, Illinois Mathematics and Science Academy

Advisor(s)

Michael Collins, Loyola University
Donald Dosch, Illinois Mathematics and Science Academy
Robyn Fischer, Illinois Mathematics and Science Academy
Kwang Hoon Moon, Loyola University
Nazhath Tajuddin, Loyola University

Toxicologists have identified ethanol (commonly referred to as alcohol) and resveratrol, a chemical created by plants and found in red wine, as two substances that have an effect on neuropathways. In fact, there is evidence that cognitive decline in neurodegenerative diseases such as Alzheimer's disease may be reduced in moderate red wine drinkers through a process called neuronal preconditioning. This experiment focuses on the treatment of a rat neuronal culture PC-12 line treated as neuronal cells with a control, low levels of ethanol, resveratrol, and a combination of ethanol and resveratrol to find whether focal adhesion kinase (FAK) and its phosphorylated form (pFAK) are upregulated in the cell. The results will be determined through Western blot analysis of the preconditioned cells, to see if there is an upregulation of FAK or pFAK. This will allow us to see if preconditioning with alcohol has any effect on protein regulation within the brain, specifically in the FAK pathway. With this knowledge, the scientific community can potentially determine whether alcohol preconditioning can prevent neurodegenerative diseases, thus preventing the onset of such diseases and saving the lives of millions.

O25**Developing an A β Oligomer-Targeted MRI Probe for Diagnosis of Alzheimer's Disease****Presenter(s)**

Summer Wu, Illinois Mathematics and Science Academy

Advisor(s)

William Klein, Northwestern University

Kirsten Viola, Northwestern University

Alzheimer's disease (AD) afflicts 5.1 million Americans and results in the loss of memory, learning, and behavior abilities. An urgent need exists for early diagnosis when therapeutic intervention has the maximum chance to succeed. Although promising, magnetic resonance imaging (MRI) is currently underutilized in AD diagnosis due to the lack of a contrast probe targeting neurotoxins specific to AD. A β oligomers are biomarkers found in the earliest stages of AD and are considered to instigate AD memory loss. In this investigation, a new MRI contrast probe was synthesized by conjugating magnetic nanostructures (MNS) with NU4 antibody that specifically targets A β oligomers. *In vitro* studies confirmed the high specificity of the probe as well as affinity similar to that of the parent antibody in binding to the target A β oligomers. Histology of transgenic mice brain slices showed positive signals after intranasal injection of the probe. These results indicated that the probe had crossed the blood-brain barrier and bound to its intended target A β oligomers. This work demonstrates that the MRI probe NU4MNS has the potential to be the first imaging tool to provide early AD diagnosis and to evaluate efficacy of therapeutic candidates at the early stages of the disease.

O26**Observing Neuron Projections in Mice Brains That Can Be Targeted When Treating Parkinson's Disease****Presenter(s)**

Ellen Zhao, Illinois Mathematics and Science Academy

Advisor(s)

Savio Chan, Northwestern University

Parkinson's disease is a neurological disorder that leads to difficulty with coordination and walking. In the disease, striatal projections to the globus pallidus external segment (GPe) are affected. The goal was to find neurons in the GPe that project back to the striatum, an area of the brain where neurons are projected to the GPe. These pallidal neurons would thus influence the striatal neurons' activity in a feedback manner that is inhibitory. Because the GPe is involved in movement control, demonstrating the existence of this population would allow the motor pathway to be better understood. By correlating the projection target with the physiological activity of the cell, more information can be learned about how these cells operate in the motor circuitry. Out of the twenty-five cells observed, we found that three projected back to the striatum. In the future, these separate neuronal populations can be differentially targeted when treating Parkinson's disease.

P01**Determining the Future for Finding the Neutrino Mass Hierarchy****Presenter(s)**

Wesley Beck, Illinois Mathematics and Science Academy

Advisor(s)

Maury Goodman, Argonne National Laboratory

Neutrinos are fundamental particles in the lepton sector that interact through the weak nuclear force. With the discovery of their oscillation in 1998 came the realization that they have non-zero mass. Amongst the currently unknown parameters of neutrino oscillation is the mass hierarchy, which is the goal for several experiments to determine. In order to evaluate which experiment would have the best chance of measuring the mass hierarchy, first, a literature review of the different experiments was done. Among those review were the Long-Baseline Neutrino Experiment, Hyper-Kamiokande, IceCube, the Indian Neutrino Observatory, the Wilkinson Microwave Anisotropy Probe, the Atacama Cosmology Telescope, the South Pole Telescope, and a radiative emission of a neutrino pair experiment. It has been determined that the best chance of discovering the mass hierarchy is the Long-Baseline Neutrino Experiment by the year 2034 due to its independence from other unknown parameters. However, further work is needed to determine if other possibilities can measure the mass hierarchy sooner. The implication of this research is that future planned experiments may not need to focus on their capability to find the mass hierarchy, which could reduce their costs.

P02**Searching for Dark Matter Using Charge-Coupled Devices****Presenter(s)**

Sharadyn Ciota, Illinois Mathematics and Science Academy

Advisor(s)

Juan Estrada, Fermi National Accelerator Laboratory

Recent experimental results hint at low-mass dark matter (DM) particles that require a low energy threshold to detect. Because of this, Fermilab is conducting an experiment using charge-coupled devices (CCDs), named dark matter in CCDs (DAMIC), to search for low-mass particles (<140 GeV) because CCDs have a low electronic readout noise, which allows a threshold of 40 eV. To reduce the radiation background noise, DAMIC was moved from Fermilab (345 m below sea level) to SNOLAB (2200 m below sea level) to decrease the background made of cosmic rays. To analyze the data from DAMIC, a code was written in C to extract data from the images and then to produce cuts specific to the image to normalize the different images' histograms to easily compare the results from Fermilab and SNOLAB to other experimental data. Our data will be compared to the annual modulation that has been seen in previous experiments. Data collection from SNOLAB began in late December and the analysis is ongoing. The data from our analysis will aid us in the DM search.

P03

Optimizing Energy Resolution in a Prototype PET Imager

Presenter(s)

Youcef Hadjarab, Illinois Mathematics and Science Academy

Kevin Li, Illinois Mathematics and Science Academy

Woohyun Shin, Illinois Mathematics and Science Academy

Advisor(s)

Pavel Murat, Fermi National Accelerator Laboratory

Positron emission tomography (PET) is a medical diagnostic imaging technique that utilizes photomultipliers, scintillators, and a radioactive tracer to construct a three-dimensional representation of a patient's body processes. Because modern PET scanners require long radiation exposure times, this investigation explored possible methods of optimizing PET performance in order to enhance image resolution and efficiency with the goal of reducing radiation exposure and the improvement of overall safety. Bias voltages were applied to a Hamamatsu multi-pixel photon counter to optimize energy and timing resolutions. The best energy resolution at the full width at half maximum (FWHM, integrated charge) achieved with an ORTEC VT120 amplifier was about 11.6%. With a Philips 776 amplifier, the best recorded energy resolution was approximately 7.4%, which compares favorably with the best results from other researchers. The best timing resolution achieved was about 260 picoseconds at FWHM with the ORTEC VT120. Analyzing individual signals with the ORTEC VT120 and the Philips 776 amplifiers demonstrated shorter leading edge widths and signal lengths with the ORTEC VT120. Varying bias voltages revealed charge correlated linearly with bias voltages while energy resolutions optimized at around -73.5 V. Excellent energy and timing resolutions means better spatial resolution and more efficient use of number of signals, expanding the potential applications of PET.

P04**Improving Coordinate Resolution in Positron Emission Tomography Detectors****Presenter(s)**

Youcef Hadjarab, Illinois Mathematics and Science Academy
Kevin Li, Illinois Mathematics and Science Academy

Advisor(s)

Pavel Murat, Fermi National Accelerator Laboratory

Positron emission tomography (PET) is a highly sensitive technique used for tracking the development of tumors and neurological disorders. One of the most important aspects of PET imagers is coordinate resolution, which is necessary for early diagnosis and locating small irregularities within the body. One method to improve coordinate resolution involves monolithic crystals attached to silicon photomultiplier (SiPM) arrays instead of the traditional approach of thin crystals paired with a single SiPM. The hardware used in this investigation included scintillating lutetium yttrium oxyorthosilicate crystals (2cm x 2cm x 2cm) wrapped in teflon tape attached to 4x4 Hamamatsu SiPM arrays receiving photons from a ^{22}Na radioactive source. Thus far, results have been obtained with regards to localizations of signals. Using a lead collimator, a tool designed to focus a light source, Hamamatsu SiPMs were found to provide accurate information with respect to the position of a photon source. The ability to localize photon sources is the key aspect of coordinate resolution and will contribute substantially to the improved functioning of commercial PET imagers. Coordinate resolutions were obtained from the monolithic detector with one-sided readout and analyzed in respect to other PET detector setups.

P05**Kaon Production by a 120 GeV/c Proton Beam With a Bismuth Target****Presenter(s)**

Emily Lindgren, Illinois Mathematics and Science Academy

Advisor(s)

Brendan Casey, Fermi National Accelerator Laboratory

The kinetic behavior and production of kaons is an important input to planning and design for future kaon experiments. This study looks at the kaon production rate by a 120 GeV/c energy proton beam incident on a bismuth target. The Main Injector Particle Production experiment at Fermi National Accelerator Laboratory collected the data studied. The data samples for this study were Monte Carlo Fluka simulations, bismuth target data and empty target data. The empty target data had to be scaled to the bismuth data and subtracted, after which the bismuth data was compared to the Monte Carlo simulations. Conditions were set to ensure that the scintillator trigger was fired, that the event took place in the proper region, that the primary vertex produced at least three tracks. This study reports the rate of production and the kinetic distribution of kaons that were identified using particle identification techniques. The kaon production is important to understand for new kaon experiments that will need to produce a specific amount of kaons to successfully run their experiments.

P06**Neutrino Oscillations: Real-World Applications on the Digital World****Presenter(s)**

Sagar Punhani, Illinois Mathematics and Science Academy

Advisor(s)

Maury Goodman, Argonne National Laboratory

Neutrino oscillations occur everywhere but are rarely detectable, requiring massive detectors. Experiments are occurring all over the world to discover the properties of neutrinos, and it is important they get digitally recorded. My project includes maintaining and updating a widely referenced website, www.neutrinooscillation.org that organizes and updates the progress of neutrino experiments across the globe. Through my research, I have found and cataloged over one hundred new and developing neutrino experiments, such as NOvA [NuMI (Neutrinos at the Main Injector) Off-Axis Electron Neutrino Appearance] and LBNE (Long-Baseline Neutrino Experiment); projects that could measure an important property of neutrinos known as the mass hierarchy of neutrino flavors. My analysis of each of the different types of experiments, outside of the website, shows neutrino groups are finding many new and sophisticated ways of detecting these particles and understanding their properties. It is vital to keep all of this information recorded on the digital realm for students, researchers, and pupils to learn about and appreciate neutrinos.

P07**The Search for Standard Model Higgs Events in Associated WH Production Resulting in the b anti- b Decay Channel With $D\bar{0}$ Data****Presenter(s)**

Benjamin Rabe, Illinois Mathematics and Science Academy

Advisor(s)

Ryuji Yamada, Fermi National Accelerator Laboratory

The force-carrying W and Z bosons of the standard model create the need for a particle, the Higgs boson, that gives them mass through electroweak symmetry breaking. While the standard model predicts the existence of this particle, it doesn't predict its mass or other properties. Here, we present a search for standard model Higgs events in associated WH production with the $l\nu b\bar{b}$ (lepton, neutrino, b , anti- b) final state using data from Run II of the $D\bar{0}$ detector at the Tevatron. The Compact Muon Solenoid (CMS) and ATLAS groups at CERN announced the discovery of the Higgs particle last year, but there has not been clear Higgs signal shown from associated WH production. The aims of this investigation were finding events that most closely exhibit properties of Higgs events and eliminating background. A multivariate analysis (MVA) was used that was trained for certain variables to categorize events based upon their likelihood of being Higgs events. This MVA helped to reject background events and increase the signal-to-background ratio. Modifications in the MVA included new/different variables with more distinct values in the studied decay process. The highest MVA output events were examined using event display software, and a series of candidate Higgs event displays was produced.

P08**Improvements to Readout Electronics for Compact Muon Solenoid Hadron Calorimeter****Presenter(s)**

Robert Schurz, Illinois Mathematics and Science Academy

Advisor(s)

Jacob Anderson, Fermi National Accelerator Laboratory

The hadron calorimeter (Hcal) of the Compact Muon Solenoid (CMS) at CERN is important to accurately measure the energy of particle showers originating from quarks and gluons. The CMS Hcal uses scintillators and hybrid photodiodes to measure the energy of particles produced in proton collisions. The CMS Hcal collaboration will be replacing the hybrid photodiodes with silicon photomultipliers (SiPM) in a series of upgrades to improve the performance and reliability of the calorimeter. We studied one key characteristic of the SiPMs, their gain, either by a light pulse from a light-emitting diode (LED) or by analyzing electronic pedestal data. Using the charge distributions of the SiPMs, we determine the gains. The root mean square of gains determined from pedestal and LED distributions is 0.35 fC and 0.93 fC, respectively. This indicates that the pedestal method is a more robust measurement technique. We also observe a systematic bias of the LED gain with respect to the pedestal gain.

P09**Analysis of Two Theories to Account for Observed Variations in the Rate of Radioactive Decay****Presenter(s)**

Abhishek Sethi, Illinois Mathematics and Science Academy

Advisor(s)

Thomas Kroc, Fermi National Accelerator Laboratory

Some measurements of the rate of radioactive decay show an annual variation. This has been observed at the Neutron Therapy Facility at Fermilab. Two theories have been proposed thus far explaining this phenomenon: humidity and solar effects. Our analysis involved the reanalysis of existing data and the collection of new data. Our first effort looked at the humidity explanation, which explains the effect through a systematic variation in the measurement process of the nuclear decay rate. We tested different gases to see the effect of the molecular weight of a gas on the decay rate. We concluded that the molar mass of a gas is directly proportional to the measured decay rate. To test the theory of solar effects, we used Matlab in order to look at the phase of the annual variation and compare it to the theory. The analysis showed that the variation in measured decay rate is contingent on the Earth's exposure of solar radiation. Variations in solar radiation or variations of the mass of the gas that is flowed through the chamber will increase the rate of radioactive decay.

P10**Effects of Spatial Resolution on the Temperature Profile of a FLASH Thermonuclear Flame Model****Presenter(s)**

Woohyun Shin, Illinois Mathematics and Science Academy

Advisor(s)

Sean Couch, University of Chicago
George Jordan, University of Chicago
Don Lamb, University of Chicago

Type Ia supernovae (SNe Ia), powerful thermonuclear explosions of carbon-oxygen white dwarf stars, are initiated by deflagrations, or subsonic nuclear burning fronts. Because varying flame resolution affects outputs of FLASH SNe Ia simulations, this investigation studied the effects of flame resolution on the temperature profile. Utilizing the FLASH code and Archimedes machine, we varied the resolution for a one-dimensional laminar flame simulation. Each simulation set a domain of zero to forty km, range of zero to 1.024×10^8 °K, one second run time, and checkpoint file frequency of 1/1,000 of a second. Increasing resolution did not significantly affect peak temperatures, but did affect the flame front width. Higher resolutions produced temperature profiles slightly hotter than those of lower resolutions, but these differences can be attributed to accelerated temperature increase. Resolution directly correlated with the steepness of the temperature profile. approximately 4.9 m resolution flame front widths were 19.53125 m long, while 625 m resolution flame front widths were 2.5 km long. Steeper temperature profiles were consistent throughout the domain. Thinner flame widths more realistically simulate deflagration, opening opportunities to develop more accurate FLASH flame models. Improved flame models can better simulate rising flame bubbles and neutronization during thermonuclear combustion.

P11**Modeling the Structural Properties of Superconducting Magnets****Presenter(s)**

Lee Tang, Illinois Mathematics and Science Academy

Advisor(s)

Tengming Shen, Fermi National Accelerator Laboratory
Ryuji Yamada, Fermi National Accelerator Laboratory

The purpose of this investigation was to create simulations of superconducting magnets using the finite element modeling software, ANSYS. During normal operation, the inner superconducting filaments of the magnets exert pressure on the silver coating of the wires. This investigation analyzed the effects of the internal pressure on the structural integrity of the magnets. Contour plots were generated by ANSYS to illustrate the axial, radial, and hoop stress on the wire. The data from these plots indicated that the points at the sealed off caps of wire were exposed to the greatest stresses. Additionally, animations were generated to illustrate the progression of the shape deformation of the magnet. The results of this investigation indicate a structural weakness in the sealed ends of superconducting magnets and that to ensure safe operation in accelerator experiments, reinforcements should be made in these vulnerable parts of the magnet.

P12**Construction of a Solenoid Magnet to Cancel the Effects of a Magnetic Field****Presenter(s)**

Lia Vallina, Illinois Mathematics and Science Academy

Advisor(s)

Thomas Gadfort, Fermi National Accelerator Laboratory

Our project aimed to cancel the effects of a magnetic field by combining two solenoid magnets with opposite field vectors. We constructed two solenoids by wrapping coils of wire around two aluminum cylinders and running a current through the wire. We calculated the number of coils and voltage necessary to produce a magnetic field larger than the one generated by Earth by using the law of Biot-Savart, an equation that expresses the field strength of a solenoid in terms of the coil density, voltage, and resistance. To produce equal and opposite fields, the voltage of the larger solenoid was half the voltage of the smaller one because its coil density was twice as large. We placed the smaller solenoid inside the larger one and collected measurements of the magnetic field using a Hall probe. The magnetic field between them doubles when the current is traveling in the same direction through both solenoids' coils, but cancels when it is traveling in opposite directions. Our design is a prototype of the inflector magnets inside particle accelerators that allow charged particles into a storage ring undisturbed by the magnetic field. Understanding how to nullify an existing magnetic field is crucial in accelerator experiments.

P13**A Measurement of Zero: Simulating a Superconducting Inflector Magnet****Presenter(s)**

Joshua Wu, Illinois Mathematics and Science Academy

Advisor(s)

Brendan Kiburg, Fermi National Accelerator Laboratory

A storage ring uses a strong magnetic force to contain muons on a certain trajectory so that their magnetic moments can be measured. In order to get the muons into this trajectory, an inflector that nullifies the magnetic field is used to set the muons at a point tangent to the field. We have built two solenoids that can produce equal and opposite magnetic fields to simulate the inflector and are using a Hall probe to measure the field within. We have run several tests to examine the precision of the probe measurements and to see if the solenoids can produce canceling fields. Analytical statistics was used to evaluate the precision. The results from these tests will be used to improve our understanding of how the inflector works.

P14**Quantum Mechanical Analysis and Control of Plasmonic Wave Packets in Silver Nanowires****Presenter(s)**

William Xu, Illinois Mathematics and Science Academy

Advisor(s)

Meishan Zhao, University of Chicago

A plasmon is a mix of incident light with surface electrons in a metal. Their interaction in nanowires is of considerable interest as silver nanowires have unexplained properties, such as faster healing with the use of nanosilver-infused bandages, that may be better understood through the development of a model. Previously, the particle-in-a-box system, with infinite potential energy barriers at its boundaries, was used to model plasmonic interaction in a silver nanowire. This gave results that were accurate enough for the wave function of the wire and correlated well with experimental evidence. However, greater accuracy can be achieved by using a square-well model with finite potential energy barriers at its boundaries. We analyzed the effects of this newly proposed model on various aspects of the nanowire, such as the wavelengths at certain points, through quantum mechanics and calculus. Our results show that the finite square-well model correlates more closely with previous experimental results than the particle-in-a-box model in one-dimensional system. Further study would be to develop a generalized quantum model for this scenario on the effects of interference in a two-dimensional situation, with two wires and two waves.

P15**Comparative Study of the Impact of Differing Progenitor Evolution on Core-Collapse Supernova Explosions****Presenter(s)**

Oleksandr Yarema, Illinois Mathematics and Science Academy

Advisor(s)

Sean Couch, University of Chicago

George Jordan, University of Chicago

Don Lamb, University of Chicago

The exact structure of the progenitors of core-collapse supernovae (CCSN) is still uncertain. Two commonly used sets of CCSN progenitors are those taken in 2002 and those taken in 2007, each set differing in only the exact nuclear reaction rates. Although both sets use progenitors with the same masses, it seems that the 2002 set is more favored by astrophysicists in modeling supernovae. I sought to see if one set really does more readily explode than the other by changing the neutrino heating efficiency from approximately 100% to 180% in order to determine the critical heating needed for a successful explosion. I have run CCSN simulations using the University of Chicago Astrophysics team's FLASH code employing progenitors from both the 2002 and 2007 sets. Based on more than thirty-five simulations, the 2002 set of progenitors does explode more readily than the 2007 set. This difference is related to the differing compactness of the progenitor cores between the two sets. The detailed nuclear reaction rates directly affect the progenitor core structures. Knowing how the readiness for explosion depends on progenitor structure and investigating any unexpected patterns will benefit the entire astrophysics community.

Q01

Effects of Childhood Trauma on the Adult Brain

Presenter(s)

Vivian Chau, Illinois Mathematics and Science Academy

Advisor(s)

Royce Lee, University of Chicago

Childhood trauma, or the repeated physical neglect, emotional neglect, physical and emotional abuse, or sexual abuse, can influence behavior in adulthood. Studies have shown that institutionally-raised children exhibit elevated symptoms of depression and anxiety. With this information, we were interested in whether or not childhood trauma affects brain activity in the adult. In this study, Childhood Trauma Questionnaires (CTQ) and electroencephalograph (EEG) tasks were given to subjects between the ages of 18 and 55 in order to find correlations between CTQ scores and P300 amplitudes (the magnitude of the EEG wave .300 seconds after a stimulus appears). By using a statistics program to find correlations, results show that there is a significant negative correlation between P300 amplitudes in EEG data and Childhood Trauma Questionnaire scores ($r=-0.483$, $p=0.007$, $n=30$). Higher CTQ scores signify more severe forms of trauma. Thus, results show that people who experienced more severe cases of childhood trauma exhibit less brain activity in the parietal lobe. Less activity in the parietal lobe of the brain suggests decreased level of memory storage, information processing, and performance in math and computation. With this understanding, predictions and preventions can be used to help children who lack sufficient parental care.

Q02

An Investigation Into the Relationship Between Evolutionary Processes and Artificial Intelligence

Presenter(s)

Michelle Kinama, Illinois Mathematics and Science Academy

Colette Moos, Illinois Mathematics and Science Academy

Tony Vadakumchery, Illinois Mathematics and Science Academy

Advisor(s)

Mike Osofsky, Applied Computer Tech.

Richard Dawkins described genes as the fundamental pieces of DNA which compete for resources and survival in order to replicate. He also coined the term meme, a social and cultural unit of replication transmitted through imitation. This investigation delves into the relationship between genetic replicators and memetic replicators, and ultimately memetic replicators and intelligence. Using qualitative analysis of texts about genetics, memetics, formal systems, and consciousness, this investigation is a grounded theory study that explains the relationship between evolutionary processes both genetic and memetic, as well as the ethical implications of the development of advanced artificial intelligence. The texts analyzed indicate that human intelligence is deeply rooted in memetics, as imitation is our main method of learning new activities and concepts. However, human intelligence itself is limited by the genetic limitations of our brain. Technology greatly facilitates memetic evolution and replication. Inventions such as smartphones and the internet increase the speed and fidelity of memetic replication. Technology at a stage where it can self-sufficiently replicate memes can be said to have artificial intelligence.

Q03

Descriptive Assessment of Social Norms at the Illinois Mathematics and Science Academy

Presenter(s)

Sophie Legan, Illinois Mathematics and Science Academy
Cristina Menchaca, Illinois Mathematics and Science Academy

Advisor(s)

David Evenson, Illinois Mathematics and Science Academy

The Illinois Mathematics and Science Academy (IMSA) is a school full of opportunity to study human behavior in a unique environment. We investigated social behaviors regarding some personal habits and interactions with others at IMSA. We emailed out a survey to all IMSA students asking questions about activities such as drug use, sleeping habits, and social interaction in order to find a relationship between perceived social norms and actual social norms, and mapped normal IMSA social interaction. According to the results we received from students, the actual occurrence of the social norms we chose to test was much lower than the perceived occurrence. We are hoping that this investigation will boost awareness of certain social norms and aid students in mending any negative behavior shown by these norms.

Q04

Impulsivity and Subjective Response to the Stimulating and Sedative Effects of Alcohol

Presenter(s)

June Qian, Illinois Mathematics and Science Academy

Advisor(s)

Harriet de Wit, University of Chicago
Jessica Weafer, University of Chicago

Individual differences in both impulsivity and subjective response to the effects of alcohol may predict alcohol abuse in the future, though little is known about the relationship between impulsivity and subjective response. The current study examines impulsivity and sensitivity to the subjective effects of alcohol in two independent samples ($n=89$ and $n=70$). At testing sessions, participants received an alcohol dose (0.65 g/kg) or a placebo, and completed several tasks. Impulsivity measures included the Barrett Impulsiveness Scale (BIS), while the Biphasic Alcohol Effects Scale (BAES), Profile of Mood States (POMS), and Drug Effects Questionnaire (DEQ) measured subjective response to alcohol. In the smaller group, analyses did not show any significant associations between impulsivity and subjective response to alcohol. From the larger sample ($n=89$), analyses showed that more impulsive people demonstrated greater stimulation and less sedation as measured by the BAES under alcohol on the ascending limb of the BAC curve. These results reflect the Newtonian Differentiator model, in which drinkers feel a greater response (more positive, stimulant-like effects) to alcohol on the ascending limb of the BAC curve. This suggests that more impulsive people may experience increased risk for alcohol abuse because they feel greater, positive rewarding effects of alcohol.

R01**Illinois Mathematics and Science Academy Students' Perceptions of Lesbian, Gay, Bisexual, Transgender, and Questioning Community Acceptance at IMSA and at Their Former Schools****Presenter(s)**

Jacob Akstins, Illinois Mathematics and Science Academy
Carissa Lao, Illinois Mathematics and Science Academy

Advisor(s)

David Evenson, Illinois Mathematics and Science Academy

This project seeks to describe, through quantitative and qualitative analysis, how students attending the Illinois Mathematics and Science Academy (IMSA) perceive community-wide acceptance of the lesbian, gay, bisexual, transgender, and questioning (LGBTQ) community at this school in comparison with their prior schools. After researching extensively, we developed a voluntary self-report survey which assessed students' acceptance of non-binary genders and sexual orientations at the Academy. While keeping privacy and student safety a top concern, we identified factors that inhibit or promote acceptance of the sexual orientations and genders of others. The results are statistically significant ($\alpha < 0.01$) and indicate that the LGBTQ community is generally accepted at the Academy, with some exceptions. In the future, this information could potentially be incorporated into diversity statistics or improve IMSA's environment to better help the LGBTQ community. These results can also help improve the Academy's diversity training and be published to inform potential applicants of these perceptions.

R02**Relationships Between Energy Interests, Agriculture, and the Environment in Contemporary America****Presenter(s)**

Harrison Dimmig, Illinois Mathematics and Science Academy

Advisor(s)

Claiborne Skinner, Illinois Mathematics and Science Academy

Continued population growth and increased adaptation of technology are pushing the production of complementary resources in America to new highs, often at the expense of one another and the environment. This investigation looked at the increasingly complex relationships between these factors, analyzing the situation from studies involving the environmental, ethical, legislative, and economic perspectives of all sides. Recent data from government sources, studies from national laboratories and universities, and news reports provided diverse and informative source material. During the investigation, it was found that while energy interests trumped agricultural ones most of the time because of greater legislative success and funding, thus limiting arable land, the environment was the ultimate loser in recent years. Toxic chemicals from fracking in the Marcellus Shale and regions in the south have killed grasslands and their inhabitants, while wind turbines across the Midwest disrupt agriculture and nature in their own ways. Much caution needs to be taken as America's energy future shifts away from coal and key infrastructure is updated. Horrible drought and shifting seasons are already wreaking havoc with crops, and show little sign of stopping. A comprehensive plan of action is urgently required to steer America successfully through the twenty-first century.

R03**Descriptive Assessment of Peer Influence Upon Attending the Illinois Mathematics and Science Academy****Presenter(s)**

Rebecca Kleina, Illinois Mathematics and Science Academy
Gregory O'Bannon, Illinois Mathematics and Science Academy

Advisor(s)

David Evenson, Illinois Mathematics and Science Academy

Each day, students at the Illinois Mathematics and Science Academy (IMSA) are faced with new pressures and influences. Students' behaviors, in dealing with drugs and alcohol, sex, and their education are each affected by positive and negative peer influences. We designed a survey to be completed by students that assesses the peer influences they've encountered while at IMSA in comparison to their previous schools. From our data, we expect to see a difference in the intensity of peer influences between IMSA and students' previous schools. Because of the importance placed on academics at IMSA, more positive educational influences and less negative drug and alcohol and sex influences are expected. We also expect to see a correlation in grade level and peer influence intensity, as well as gender and peer influence intensity. Our data could be useful in helping more students and faculty at IMSA better understand the peer influences at IMSA, which would help them to better handle them.

R04**Strategy and Tactics of Ancient Warfare From 499 BCE to 14 CE****Presenter(s)**

Hankyul Lee, Illinois Mathematics and Science Academy

Advisor(s)

Lee Eysturlid, Illinois Mathematics and Science Academy

From the Classical Greece to the Roman Empire, strategies in warfare and tactics on the battlefield have evolved greatly. The method in which armies conducted battle changed significantly over five hundred years, from 499 BCE to 14 CE. Information on the strategies and tactics involved in select battles was analyzed through the use of numerous primary and secondary sources. From these analyses, general trends in the conduct of warfare were identified. In the Classical Greek era, the Greek hoplite dominated warfare, using the feared phalanx formation to defeat large groups of light infantry and cavalry. As time progressed towards Hellenistic Greece, the slow phalanx was scrapped in favor of a more mobile group of spear infantry, known as phalangists. The Roman Republic became known for its use of its legions, tough groups of heavy infantry deployed in maniples that carried the strength of the phalanx, and the mobility of the phalangists. However, the Roman Empire saw a rise in the strength of cavalry-based armies that could exploit their mobility against these heavy infantry columns. The investigation concludes that from Classical Greece to Imperial Rome, warfare saw a transition from slow and heavy infantry to fast and mobile cavalry.

R05**The Distinct Rhetorical Tendencies of Democrats and Republicans****Presenter(s)**

Anthony John Marquez, Illinois Mathematics and Science Academy
Erma Mladenova, Illinois Mathematics and Science Academy

Advisor(s)

Tracy Townsend, Illinois Mathematics and Science Academy

Rhetoric is a tool used to persuade an audience and substantiate claims through various methods, such as the three rhetorical pleas of Ethos, Pathos, and Logos. The focus of this investigation was to determine whether there is a correlation between a politician's political affiliation and their use of certain rhetorical pleas. This investigation consisted in the compilation of data which demonstrates how often rhetorical pleas are used by Democrats and Republicans, respectively. A collection of nearly seventy-five political speeches, ads, and debates by presidential candidates from 1980-2012 were analyzed. Upon examination of these various rhetorical artifacts, it became evident that the Democrats more frequently incorporated Logos, which is the use of specific facts or logical reasoning, while the Republicans displayed a propensity towards Pathos, the appeal to the emotional senses of an audience. Furthermore, when a comparison of the use of rhetoric by candidates from the same party was performed, a significant distinction between the type of rhetoric used was not evident. Ultimately, our study demonstrates the different approaches in delivery of information between Democrats and Republicans, articulating the difference in their political portfolios beyond a contrast in ideology.

R06**The Implications of Gender and Culture on Body Image****Presenter(s)**

Karen Olowu, Illinois Mathematics and Science Academy
Isabella West, Illinois Mathematics and Science Academy

Advisor(s)

Kathryn Grubbs, Illinois Mathematics and Science Academy

Body image, a subjective view of an individual's physical appearance, is a result of an individual's self esteem and their personal evaluation of their body. This study investigated how an IMSA student's gender and cultural background influenced their view of their ideal body type for both their sex as well as for the opposite sex. Following a literature review, we became aware of the importance of cultural background in constructing personal body image. We also found a set of body mass index (BMI) silhouettes used in other studies, which we altered and then included in our Institutional Review Board approved survey. Using Vassar Stats, we were able to analyze the results from the two hundred and fifty students we surveyed. Our results indicated varying body type preferences for individuals of different genders and cultural backgrounds. Despite the absence of a statistically significant difference across cultural groups for gender or cultural BMI preferences, within cultural groups there were gender preferences for different BMI categories. Further analysis of data supported evidence of the importance of both cultural and gender roles in deciding an individual's body type preference. Limitations of our study, such as its small sample size, as well as implications for further studies are also discussed.

R07

Investigating the Portrayal and Comparison of Stereotypes Between Japanese and Western Media

Presenter(s)

Arjun Sarode, Illinois Mathematics and Science Academy

Advisor(s)

Jonathan Besancon, Illinois Mathematics and Science Academy

Stereotypes are often seen in media and are useful in determining key ideals of the culture. I examined various Japanese media sources such as anime, dramas, and books to find evidence of Japanese stereotypes. I focused on the common perception of the Japanese relationships such as the way men flirt, how they treat friends, and how they treat strangers. I found that Japanese relationships differ from the way characters commonly behave in Western media sources. Qualitative analysis of dialogue and interactions between characters in the media sources was used to obtain evidence of these stereotypes. I recorded any dialogue that directly showed an example of a stereotype being either supported or discredited. The evidence supports that Japanese relationship patterns are very similar to the way interactions are portrayed in Western media sources. These results lessen that accuracy of stereotypes and the ideology of foreign cultures being radically different from our own. These similarities support the claim that stereotypes portray some similarities in culture between both Japanese and Western media. My results caution against the ideology of foreign cultures being radically different from our own.

S01

The Frequency of Exoplanets Around Stars

Presenter(s)

Jonathan Hu, Illinois Mathematics and Science Academy
Steven Kosvick, Illinois Mathematics and Science Academy

Advisor(s)

Jacob Bean, University of Chicago

The frequency of planets around other stars is a fundamental constraint on the theories of planet formation. We used the February 27th, 2012 data from NASA's Kepler mission to put new constraints on exoplanet frequency. Kepler uses the transit-detection method to measure the radii of the planets. In this study, we only considered exoplanets with radii from 0-20 Earth radii and orbital periods from 0-50 days. Within these parameters, results showed that most exoplanets found were small planets and that exoplanet frequency increases as orbital period increases. In addition, results also showed that Sun-like stars have a 65% chance of having at least one planet orbiting it. Due to the high number of small planets and the correlation between planet frequency and orbital period, our results suggest that the number of planets that could possibly hold extraterrestrial life may be higher than scientists previously thought. Further studies should be pursued in regards to determining the number of exoplanets in the habitable zones of their host stars, as more results could further assist researchers in determining the probability of extraterrestrial life occurrence on any given exoplanet.

S02

Mining of Precious Metals From Near-Earth Asteroids

Presenter(s)

Mohamed Kady, Illinois Mathematics and Science Academy

Advisor(s)

Mark Hammergren, Adler Planetarium

My investigation addresses the feasibility and prospects of asteroid mining in the near future. The mining of platinum from near-Earth asteroids is the most likely and most commonly cited destination/resource for asteroid mining. Literature review has led to potential candidates for asteroid mining based on the platinum concentration in meteorites and the resources required to refine the platinum. By compiling the platinum concentrations of 152 metallic meteorites, a mean 90th percentile concentration of 35.6 ppm was calculated. This is well below Planetary Resources', a prospective asteroid-mining company, claims of 64-73 ppm for an ideal platinum-rich asteroid. In accordance, it seems that the number of known viable specimens that fit the ideal mining asteroid is relatively low as well, with only a calculated 3% of near-Earth asteroids being metallic. Finally, even with prototype variable specific impulse magnetoplasma rocket fuel technology, the amount of fuel required would result in a cost of \$2100 to \$2900 per returned troy ounce of material, exceeding the current market value of platinum. So, even without taking mining operations and spaceship development cost, asteroid mining does not seem realistic or profitable in the near future.

2011-2012 Student Recognition

The below accomplishments are a summary from the 2011-2012 academic year

Soham Ali: Analysis of Colorectal Cancer Risk Factors in E-Cadherin in Diverse Patient Populations
Advisors: Nathan Ellis, Shilpa Ravella; University of Illinois at Chicago
Presented at the International Student Science Fair, April 30 – May 4, 2012 in Winnipeg, Manitoba, Canada

Courtney Amegashie: Concentration Effect of Chemically-Induced Hypoxia on the Metastasis of High Nitric Oxide Adapted and Non-Adapted Cancer Cells
Advisor: James Radosevich; University of Illinois at Chicago
Presented at the University of Illinois at Chicago College of Dentistry Clinic and Research Day, March 8, 2012 in Chicago, Illinois; DuPage County ACT-SO (Afro-Academic, Cultural, Technological and Scientific Olympics) gold medal winner in biochemistry

Courtney Amegashie: The Comparison of Motility in Parent Versus High Nitric Oxide Adapted Cells
Advisor: James Radosevich; University of Illinois at Chicago
DuPage County ACT-SO (Afro-Academic, Cultural, Technological and Scientific Olympics) Competition gold medal winner in biology

Wendy Bindeman: The Expression of MDS1 and EVI1 Complex Locus in Seven Cancer Cell Lines
Advisor: Don Dosch, Illinois Mathematics and Science Academy
Presented at the American Junior Academy of Sciences conference at the American Association for the Advancement of Science annual conference, February 15-19, 2012 in Vancouver, British Columbia, Canada

Alice Chang: The Role of Simulation in Neurosurgical Education: A Survey of 99 United States Neurosurgery Program Directors
Advisors: Aruna Ganju and Lisa Glatz, Northwestern University
Co-author of paper published in World Neurosurgery, November 24, 2012, (Aruna Ganju, Salah G. Aoun, Marc R. Daou, Tarek Y. El Ahmadi, Alice Chang, Lucy Wang, H. Hunt Batjer, Bernard R. Bendok)

Zi-Ning Choo: Genes that are Upregulated and that Show Alternative Splice Variations are Revealed by Exon Microarray Analysis of Pure CSMN Isolated from Disease Models of ALS
Advisor: P. Hande Özdinler, Northwestern University
Poster presented at 20th Annual Meeting International Alliance of ALS/MND Associations and 23rd International Symposium on ALS/MND, December 2-7, 2012 Chicago, IL (Javier H. Jara, Zi-Ning Choo, Ted Li, and P. Hande Özdinler)

Yiyun Cao: Regulation and Role of Regulator of G-protein Signaling-1 in Celiac Disease Pathogenesis
Advisors: Bana Jabri, Cezary Ciszewski; University of Chicago
Siemens Competition Regional Semi-Finalist; Intel Science Talent Search semi-finalist; Illinois Junior Academy of Sciences Project Exposition Finalist; Intel International Science and Engineering Fair finalist; Chicago Region Junior Science and Humanities Symposium Finalist; Chicago Region third place winner

Henry Deng: Networks of Ultrasmall Pd/Cr Nanowires as High Performance Hydrogen Sensors
Advisors: Zhi-Li Xaio, Hsien-Hau Wang, and Michael Latimer; Argonne National Laboratory
Published in ACS Nano, 2011, 5 (9), pp 7443–7452; Publication Date (Web): August 22, 2011 (Article)
DOI: 10.1021/nn2023717 (Xiao-Qiao Zeng, Yong-Lei Wang, **Henry Deng**, Michael L. Latimer, Zhi-Li Xaio, John Pearson, Tao Xu, Hsien-Hau Wang, Ulrich Welp, George W. Crabtree, and Wai-Kwong Kwok); *Presented at the American Junior Academy of Sciences conference at the American Association for the Advancement of Science annual conference, February 15-19, 2012 in Vancouver, British Columbia, Canada*

Sruthi Doniparthi: CDDO Inhibits TGF-Beta-Induced EMT in A549 Lung Epithelial Cells via the P13K/AKT Pathway
Advisors: Jun Wei and John Varga; Northwestern University
Siemens Competition Regional Semi-Finalist; Chicago Region Junior Science and Humanities Symposium Finalist

Johnny Duan: Runx2 Contributes to Murine *Col10a1* Gene Regulation Through Direct Interaction with Its Cis-Enhancer
Advisor: Qiping Zheng; Rush University Medical Center
Published in Journal of Bone and Mineral Research (2011). 26 (12) pp 2899-2910. (Feifei Li, Yaojuan Lu, Ming Ding, Dobrawa Napierala, Sam Abbassi, Yuqing Chen, Xiangyun Duan, Siying Wang, Brendan Lee, and Qiping Zheng)

Nicholas Fung: The Effect of Poly I:C on Transforming Growth Factor- β (TGF β)-Induced Fibrotic Responses
Advisors: Feng Fang and John Varga; Northwestern University
Co-presented at the Eighth Annual Lewis Landsberg Research Day at Northwestern University, April 5, 2012 in Chicago, Illinois (Feng Fang, Nicholas Fung, John Varga)

Annie Guo: Institutional Review Board Unanticipated Problems Involving Risks to Subjects or Others Reports Lack Sufficient Information to Determine Causality
Advisors: Steven Belknap, Debra Tice Gibson, Dennis West; Northwestern University
Co-author of poster presented at the Eighth Annual Lewis Landsberg Research Day at Northwestern University, April 5, 2012 in Chicago, Illinois (Mai, Guo, Belknap, Tice Gibson, West)

Brinda Gupta: Effect of 1-methyl-4-phenylpyridinium (MPP+) on Dopamine Neuron Loss in LPS Mouse Model of Parkinson's Disease
Advisors: Paul Carvey, Bill Hende; Rush University Medical Center
Presented at the American Junior Academy of Sciences conference at the American Association for the Advancement of Science annual conference, February 15-19, 2012 in Vancouver, British Columbia, Canada; Presented at the 2012 Meeting of the Society for In Vitro Biology, June 3 - 7, 2012, Bellevue, Washington

Rae Hohle: Exploring The Relationship Between Metabolic Acid Base Status and The Number of Apnea, Bradycardia, and Desaturation Alarms In Infants 27-32 Weeks Gestation in The First Two Weeks of Life.
Advisor(s): Christine Sajous & Pat Hummel, Loyola University
Presented at the Midwest Society for Pediatric Research, Inc., Oct 4-5, 2012, in Columbus, OH. (R Hohle, A Warhekar, PA Hummel, and CH Sajous)

Jennifer Huang: Development of an Improved Soft Agar Method
Advisors: Kim Elseth, Benjamin Vesper, Maaly Bassiony, Bulent Aydrogan, and James Radosevich;
University of Illinois at Chicago

Poster co-presented at the University of Illinois at Chicago College of Dentistry Clinic and Research Day, March 8, 2012 in Chicago, Illinois (Jennifer Huang, Melissa Kim, Kim M. Elseth, Benjamin J. Vesper, Maaly Bassiony, Bulent Aydrogan, James A. Radosevich)

Aadam Ibrahim: FTIR in Pharmacology
Advisor: Carol Hirschmugl; University of Wisconsin at Madison

Poster presented at the 2011 Synchrotron Radiation Center Users' Meeting, September 16-17, 2011 at the University of Wisconsin at Madison, Wisconsin

Taylor Imburgia: Examining the Levels of Overexcitabilities of IMSA Sophomores

Advisors: Christopher Kolar, Deb McGrath, Illinois Mathematics and Science Academy

Presentation at the 10th Annual Dabrowski Conference, July 19-21, 2012 in Denver, Colorado

Adam Kalinich: Flipping the Winner of a Poset Game

Advisor: Lance Fortnow; Northwestern University

Published in Information Processing Letters (2012). 86, pp 86-89. (Adam Kalinich); Intel Science Talent Search Semi-Finalist and Finalist

Nilesh Kavthekar: Collagen-Hyaluronic Acid Membranes for Tissue Regeneration

Advisor: Justin Liu; Northwestern University

Siemens Competition Regional Semi-Finalist; Illinois Junior Academy of Sciences Project Exposition Finalist; IJAS Region V Special Award: U.S. Army Special Award for Engineering; IJAS State Project Exposition Gold Award Winner; IJAS State Best in Category Award in Materials Science; Intel International Science and Engineering Fair finalist

Emil Khabiboulline: Modeling of Quench Protection Techniques in Superconducting Solenoid Magnets

Advisor: Iouri Terechkine; Fermi National Accelerator Laboratory

Siemens Competition Regional Semi-Finalist; Presented at the American Junior Academy of Sciences conference at the American Association for the Advancement of Science annual conference, February 15-19, 2012 in Vancouver, British Columbia, Canada

Melissa Kim: Development of an Improved Soft Agar Method

Advisors: Kim Elseth, Benjamin Vesper, Maaly Bassiony, Bulent Aydrogan, and James Radosevich;
University of Illinois at Chicago

Poster co-presented at the University of Illinois at Chicago College of Dentistry Clinic and Research Day, March 8, 2012 in Chicago, Illinois (Jennifer Huang, Melissa Kim, Kim M. Elseth, Benjamin J. Vesper, Maaly Bassiony, Bulent Aydrogan, James A. Radosevich)

Shannon Kurian : The role of *SGK1* and *RERK* in Cell Proliferation and Apoptosis in Endometriotic Cells

Advisors: Serdar Bulun, Diana Monsivais

Co-presented at the Eighth Annual Lewis Landsberg Research Day at Northwestern University, April 5, 2012 in Chicago, Illinois, Diana Monsivais, Shannon Kurian, Monica Patel, Serdar Bulun

Jenny Lee: Gold Ion–Angiotensin Peptide Interaction by Mass Spectrometry

Advisor: Bao-Shiang Lee; University of Illinois at Chicago

Published in the Journal of the American Society for Mass Spectrometry (2012) published online February 2012; Doi: 10.1007/s13361-011-0328-0 (Jenny Lee, Lasanthi P. Jayathilaka, Shalini Gupta, Jin-Sheng Huang, Bao-Shiang Lee)

John Lee: Characterization of Linear-Dendron Based Micelle Formulations

Advisor: Jonathan Paley; Argonne National Laboratory

Presented at the Ninth Annual RITS Super Science Fair, Nov. 19-17, 2011 in Kyoto, Japan

Shelly Li: Thymoquinone Inhibits Cigarette Smoke Extract-Induced SiHa Cell Invasion

Advisor: Kenneth Alexander, University of Chicago

Illinois Junior Academy of Sciences Project Exposition Finalist; IJAS Region V Special Award: Naval Science Award; IJAS State Project Exposition Gold Award Winner

Ted Li: Genes that are Upregulated and that Show Alternative Splice Variations are Revealed by Exon Microarray Analysis of Pure CSMN Isolated from Disease Models of ALS

Advisor: P. Hande Özdinler, Northwestern University

Poster presented at 20th Annual Meeting International Alliance of ALS/MND Associations and 23rd International Symposium on ALS/MND, December 2-7, 2012 Chicago, IL (Javier H. Jara, Zi-Ning Choo, Ted Li, and P. Hande Özdinler)

Xiaoyu Li: Dopamine Regulation of Cone-Cone Gap Junctions in Ground Squirrel Retina

Advisor: Steven DeVries; Northwestern University

Published in the Journal of Experimental Secondary Science, October 2011

Xiaoyu Li: Organizational Motifs for Ground Squirrel Cone Bipolar Cells

Advisor: Steven DeVries; Northwestern University

Published in the Journal of Comparative Neurology. (online February, 2012). Adam C. Light, Yongling Zhu, Jun Shi, Shannon Saszik, Sarah Lindstrom, Laura Davidson, Xiaoyu Li, Vince A. Chiodo, William W. Hauswirth, Wei Li and Steven H. DeVries. (DOI: 10.1002/cne.23068)

Claire Liang: Modeling Spatial Growth Dynamics of Stem Cell in Tissue Growth and Regeneration

Advisors: Qing Nie and Youfang Cao; University of California at Irvine and University of Illinois at Chicago

Co-author of paper presented at the Illinois Workshop on Regenerative Biology and Tissue Engineering, November 18, 2011; Illinois Junior Academy of Sciences Project Exposition Finalist; IJAS State Project Exposition Gold Award Winner; IJAS State Best in Category Award in Cellular and Molecular Biology

Peter Lu: Nonequilibrium Dynamics in Cuprate Superconductors Using Transient Grating Spectroscopy

Advisors: Nuh Gedik and Fahad Mahmood; Massachusetts Institute of Technology

Siemens Competition Regional Semi-Finalist

Rahul Maheswari: IL-10 Expression Surrounding Neuromuscular Junctions in the mSOD1 Mouse Model of ALS

Advisor: Nichole Mesnard; University of Illinois at Chicago

Poster presented at the American Association of Anatomists regional meeting, February 25, 2012, Rush University Medical Center, Chicago, Illinois; Second Place Award in the High School Student Poster Competition

Anuj Marathe: Heat Shock Protein 70 Regulates Interleukin 10 Producing Regulatory T Cells
Advisors: Eugene Chang, Yunwei Wang; University of Chicago
Illinois Junior Academy of Sciences Project Exposition Finalist¹; Illinois Junior Academy of Sciences Paper Exposition Finalist; IJAS State Paper Exposition Gold Award Winner; IJAS State Project Exposition Gold Award Winner; Intel International Science and Engineering Fair finalist; Chicago Region Junior Science and Humanities Symposium Finalist and Chicago Region runner-up

Sarah Martin: TNF α Expression Surrounding Neuromuscular Junctions in the mSOD1 Mouse Model of ALS
Advisor: Nichole Mesnard; University of Illinois at Chicago
Poster presented at the American Association of Anatomists regional meeting, February 25, 2012, Rush University Medical Center, Chicago, Illinois

Aalap Mehta: The Role of RBP2 in MCF-7 Cancer Cell Drug Resistance
Advisor: Elizaveta Benevolenskaya; University of Illinois at Chicago
Illinois Junior Academy of Sciences Project Exposition Finalist¹; IJAS Special Award: Society for In Vitro Biology Award; Illinois Junior Academy of Sciences Paper Exposition Finalist; IJAS State Paper Exposition Gold Award Winner; IJAS State Project Exposition Silver Award Winner

Thitipong Mongkolrattanothai: Ranolazine Inhibition of the Late Sodium Ion Current Slows the Progression of Heart Failure, Disorganization of T-tubules, and Hypertrophy of the Heart
Advisors: James Kelly, Amanda Nahhas, Matthew O'Toole, and J. Andrew Wasserstrom; Northwestern University
Presented at the International Student Science Fair, October 8-15, 2011, in Bangkok, Thailand

Laura Napierkowski: R&D for the Tracking Detector for the Muon g-2 Experiment at Fermi National Accelerator Laboratory
Advisor: Mandy Rominsky; Fermi National Accelerator Laboratory
Presented at the American Physical Society April Meeting 2012, March 31 - April 3, 2012, Atlanta, Georgia

Deokgeun Park: Initial Calibration of CCD Images for the Dark Energy Survey
Advisors: H. Thomas Diehl and Douglas Tucker; Fermi National Accelerator Laboratory
Published in the Journal of Experimental Secondary Science, October 2011; Illinois Junior Academy of Sciences Region V Project Exposition participant; IJAS Region V Special Award: U.S. Air Force Special Award; Chicago Region Junior Science and Humanities Symposium Finalist

Monica Patel: The role of *SGK1* and *REG1A* in Cell Proliferation and Apoptosis in Endometriotic Cells
Advisors: Serdar Bulun, Diana Monsivais
Co-presented at the Eighth Annual Lewis Landsberg Research Day at Northwestern University, April 5, 2012 in Chicago, Illinois, (Diana Monsivais, Shannon Kurian, Monica Patel, Serdar Bulun)

Shivani Patel: Immunohistochemical Localization of HCN1-4 Channels in the Mouse Brain
Advisor: Dane Chetkovich; Northwestern University
Presented at the International Student Science Fair, April 30 – May 4, 2012 in Winnipeg, Manitoba, Canada

Nishith Reddy: The Effect of Transgenic MA20 on Inflammation of the Intestinal Epithelium
Advisor: David Boone; University of Chicago
Siemens Competition Regional Semi-Finalist; Presented at the American Junior Academy of Sciences conference at the American Association for the Advancement of Science annual conference, February 15-19, 2012 in Vancouver, British Columbia, Canada

Sarah Salameh: Early Events in Herpes Simplex Virus Lifecycle with Implications for an Infection of Lifetime
Advisor: Deepak Shukla; University of Illinois at Chicago
Published in The Open Virology Journal (2012) Vol. 6, pp 1-6 (Sarah Salameh, Urmi Sheth, and Deepak Shukla)

Urmi Sheth: Early Events in Herpes Simplex Virus Lifecycle with Implications for an Infection of Lifetime
Advisor: Deepak Shukla; University of Illinois at Chicago
Published in The Open Virology Journal (2012) Vol. 6, pp 1-6 (Sarah Salameh, Urmi Sheth, and Deepak Shukla)

Yanchen Shi: A Low-Power Wave Union TDC Implemented in FPGA
Advisor: Jinyuan Wu; Fermi National Accelerator Laboratory
Co-author of paper presented at the Topical Workshop on Electronics for Particle Physics 2011 (TWEPP-11), September 26-30, 2011 in Vienna, Austria (Jinyuan Wu, Yanchen Shi, Douglas Zhu)

Rose Neiberg Sloan: Stable Expansions of the Integers
Advisor: David Marker; University of Illinois at Chicago
Intel Science Talent Search semi-finalist

Michelle Suh: The Comparison of the Different Radiotherapy Neutron Sources in Various Facilities for the Optimal Result in Neutron Therapy
Advisor: Thomas Kroc; Fermi National Accelerator Laboratory
Presented at the International Student Science Fair, October 8-15, 2011, in Bangkok, Thailand; Presented at the American Junior Academy of Sciences conference at the American Association for the Advancement of Science annual conference, February 15-19, 2012 in Vancouver, British Columbia, Canada

Shannon Tai: Increased Heterogeneity of Calcium Cycling in Myocytes from Failing Hearts
Advisor: J. Andrew Wasserstrom; Northwestern University
Presented at the Ninth Annual RITS Super Science Fair, Nov. 19-17, 2011 in Kyoto, Japan

Lee Tang: Modulation of the Akt/Protein Kinase B Pathway in Human Neutrophils Through the Inhibition of Phosphatase and Tensin Homolog and PH Domain Leucine-Rich Repeat Protein Phosphatase
Advisor: Xiangdong Zhu; University of Chicago
Illinois Junior Academy of Sciences Paper Exposition participant

Riva Trivedi: A Comparison of Drosophila CMI to Human MLL2/ALR Reveals Homologous Histone Binding and Recognition Preferences

Advisors: Claudia Zraly and Andrew Dingwall; Loyola University

Co-author of paper published in the Journal of Secondary Science, October 2012; (Riva Trivedi, Claudia Zraly, and Andrew Dingwall)

Rheanna Vimawala: Factors Influencing Successful Discontinuance of Caffeine at 34 Weeks Corrected Gestational Age in Premature Infants Treated for Apnea of Prematurity

Advisors: Christine Sajous and Bonnie Kanzia, Loyola University

Presentation at the Midwest Society for Pediatric Research, Inc., Oct 4-5, 2012, in Columbus, OH. (R Vimawala, PA Hummel, and CH Sajous)

Lucy Wang: The Role of Simulation in Neurosurgical Education: A Survey of 99 United States Neurosurgery Program Directors

Advisors: Aruna Ganju and Lisa Glatz, Northwestern University

Co-author of paper published in World Neurosurgery, November 24, 2012, (Aruna Ganju, Salah G. Aoun, Marc R. Daou, Tarek Y. El Ahmadi, Alice Chang, Lucy Wang, H. Hunt Batjer, Bernard R. Bendok)

Aditi Warhekar: Exploring The Relationship Between Metabolic Acid Base Status and The Number of Apnea, Bradycardia, and Desaturation Alarms In Infants 27-32 Weeks Gestation in The First Two Weeks of Life.

Advisors: Christine Sajous and Pat Hummel, Loyola University

Presented at the Midwest Society for Pediatric Research, Inc., Oct 4-5, 2012, in Columbus, OH. (R Hohle, A Warhekar, PA Hummel, and CH Sajous)

Jordan Williams: The Effect of Silver Ion on Sewage Treatment Bacteria

Advisors: Megan Schrementi and Mark Carlson, Illinois Mathematics and Science Academy

Presented at the Ninth Annual RITS Super Science Fair, Nov. 19-17, 2011 in Kyoto, Japan

Summer Wu: Characterization and Manipulation of Nanorods via an Applied Magnetic Field

Advisors: Shih-han Lo, Vinayak Dravid; Northwestern University

Illinois Junior Academy of Sciences Project Exposition Finalist; IJAS Region V Special Awards: Mu Alpha Theta Award and Yale Science and Engineering Association, Inc. (YSEA) Science Fair Award; Illinois Junior Academy of Sciences Paper Exposition Finalist; IJAS State Paper Exposition Gold Award Winner; IJAS State Project Exposition Gold Award Winner; IJAS State Best in Category Award in Materials Science; Midwest Research Competition: Positive Impact finalist

Douglas Zhu: A Low-Power Wave Union TDC Implemented in FPGA

Advisor: Jinyuan Wu; Fermi National Accelerator Laboratory

Co-author of paper presented at the Topical Workshop on Electronics for Particle Physics 2011 (TWEPP-11), September 26-30, 2011 in Vienna, Austria (Jinyuan Wu, Yanchen Shi, Douglas Zhu)

Note: Mahi Singh's research from the 2010 and 2011 academic years was published in 2013.

Mahi Singh (Class of 2011): *Dnmt3b* Is a Haploinsufficient Tumor Suppressor Gene in *Myc*-Induced Lymphomagenesis

Advisors: Lucy Godley, Aparna Vasanthakumar, and Janet Lepore; University of Chicago

*Co-author of paper published in Blood, March 14, 2013 (Aparna Vasanthakumar, Janet B. Lepore, Matthew H. Zegarek, Masha Kocherginsky, **Mahi Singh**, Elizabeth M. Davis, Petra A. Link, John Anastasi, Michelle M. Le Beau, Adam R. Karpf, and Lucy A. Godley)*

Index

Poster/ Abstract Number	Page Number	Name	Time	Room
I01	73	Michael Adams	09:10	A-133
N01	90	Prachi Aggarwal	10:00	A-147
R01	127	Jacob Akstins	09:35	Lect. Hall B-206
K01	80	Simone Alexandrova	2:10	B-133
C01	43	Soham Ali	10:50	A-135
M01	86	Andrew Alonso-Emanuel	09:35	B-133
N02	90	Charlene Angeles	12:55	A-133
A01	35	Ashok Arjunakani	09:35	A-115
O01	101	Ashok Arjunakani	10:25	A-113
K02	81	Lydia Auch	09:10	Acad. Pit A-138
D01	58	Martin Bantchev	12:55	Lect. Hall B-206
P01	117	Wesley Beck	12:55	A-121
K03	82	Sarah Blanco	09:10	Lect. Hall B-206
C02	43	Isiah Butler	10:50	A-151
I02	74	Kendell Byrd	09:10	Kids Inst. E-115
J01	78	Kirstyn Carlson	11:15	A-149
Q01	125	Vivian Chau	1:20	A-131
F01	65	Advitheey Chelikani	10:50	A-149
O02	102	Gary Chen	09:10	B-133
I03	74	Brian Chien	1:45	A-131
O03	102	Kathleen Chinetti	10:50	B-116
N03	91	Ryan Chiu	09:35	A-155
C03	44	Zi-Ning Choo	1:45	A-115
P02	117	Sharadyn Ciota	1:45	A-151
M02	87	Lael Costa	1:45	A-135
A02	35	Molly Cuka	11:15	Acad. Pit A-138
C06	45	Jonathan D'Souza	10:00	A-135
C04	44	John Deng	2:10	A-121
E01	59	Matthew Deng	2:10	Acad. Pit A-138
I04	75	Evan Derse	10:00	Acad. Pit A-138
K02	81	Grace DiCecco	09:10	Acad. Pit A-138
R02	127	Harrison Dimmig	09:35	A-147
C05	45	Vishrut Dixit	12:30	A-147
F02	65	Ryan Eberhardt	1:20	Lect. Hall B-206
N04	91	Kevin Emancipator	08:45	A-115
K02	81	Kenzo Esquivel	09:10	Acad. Pit A-138

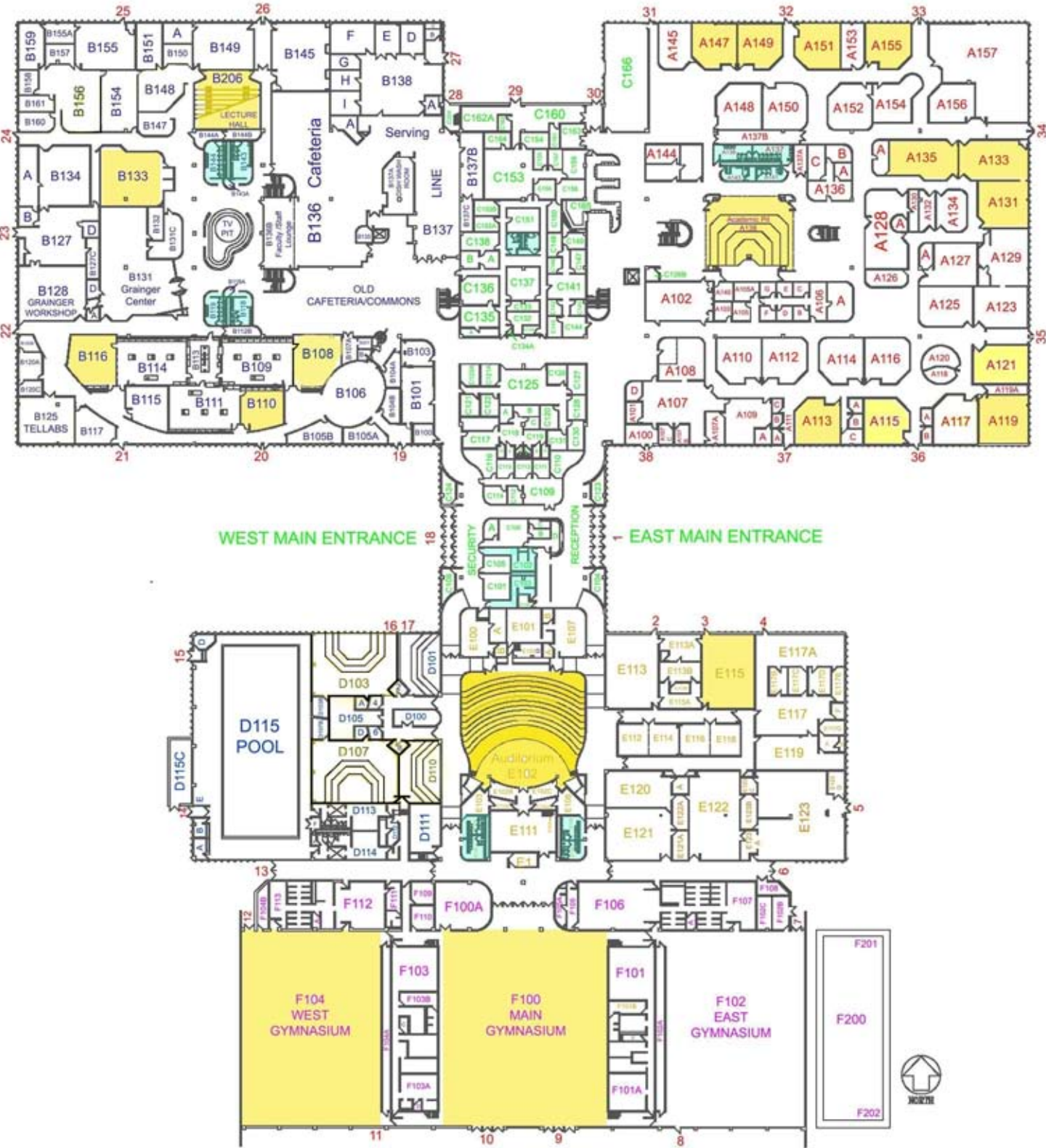
O04	103	Anastasia Fafara	12:30	Kids Inst. E-115
C07	46	Kristy Fang	11:15	B-108
B01	39	Emerald Fikejs	1:20	A-155
C08	47	Marisol Flores	2:10	B-108
I01	73	Daniel Francis	09:10	A-133
O05	103	Kent Gang	10:25	Acad. Pit A-138
E01	59	Kent Gang	2:10	Acad. Pit A-138
E01	59	Siva Gangavarapu	2:10	Acad. Pit A-138
F03	66	Amanda Gao	08:45	A-135
N05	92	Arjun Garg	08:45	A-151
N06	92	Aaron Geldner	10:00	A-151
F04	66	Jackson Gibbons	1:20	A-133
C09	47	Ellen Gieser	09:10	A-155
C10	48	Shivani Goel	11:15	Kids Inst. E-115
N07	93	Annika Gomez	10:50	A-155
K04	82	Anna Gupta	10:50	A-119
H01	72	Ashima Gupta	08:45	Acad. Pit A-138
C08	47	Estefany Guzman	2:10	B-108
P03	118	Youcef Hadjarab	09:10	A-131
P04	119	Youcef Hadjarab	09:35	A-131
A03	36	Clarreesa Hardin	1:20	A-115
O06	104	Stephanie Hatz	12:55	A-119
M03	87	Kevin He	11:15	A-133
I05	75	Claire Hensley	1:20	A-119
I01	73	Jennifer Hoelzer	09:10	A-133
O07	104	Kevin Hong	1:20	B-133
B02	40	Isheng Hou	09:35	A-135
S01	130	Jonathan Hu	2:10	A-155
C11	48	Jimmy Huang	09:35	A-151
L01	85	Nathan Huxtable	10:50	A-147
O08	105	Shreya Jain	10:50	A-115
J02	79	Alexander Johnson	09:10	B-110
N08	93	Tejas Joshi	09:35	B-108
S02	131	Mohamed Kady	10:00	A-133
C12	49	Vandana Karan	12:55	A-135
H02	73	Anton Karpovich	10:50	Lect. Hall B-206
N09	94	Kaylee Kauffman	10:50	B-110
M04	88	Samuel Kaufman	09:35	Kids Inst. E-115
O09	105	Omkar Kelkar	09:10	A-113
O10	106	Omkar Kelkar	09:35	A-113
N10	94	Akram Khaja	08:45	B-116

C13	49	Kathryn Kim	11:15	B-133
Q02	125	Michelle Kinama	2:10	Kids Inst. E-115
E02	60	Ujwal Kiran	10:00	A-121
D01	59	Pirapat Kitipongpatana	12:55	Lect. Hall B-206
R03	128	Rebecca Kleina	10:00	Lect. Hall B-206
S01	130	Steven Kosvick	2:10	A-155
C14	50	Srisha Kotlo	10:00	A-119
F02	65	Milosz Kowal	1:20	Lect. Hall B-206
G01	70	Samuel Krause	10:25	A-147
E03	60	Jacob Kronenberg	11:15	A-119
O08	105	Anna Kryczka	10:50	A-115
K05	83	Anna Kryczka	1:45	A-119
N11	95	Anna Krzywiec	1:20	B-110
O02	102	Dipen Kumar	09:10	B-133
O11	107	Nishita Kumar	1:45	B-133
F05	67	Saurabh Kumar	08:45	A-155
N12	96	Shannon Kurian	12:55	B-110
G02	71	Andrew Kuznetsov	11:15	B-116
C15	50	Maria Kuznetsov	10:25	A-155
C16	51	Jiwon Kwak	09:10	A-151
C17	51	Jennifer Kwon	10:50	B-108
N13	96	Joshua Lam	09:10	B-108
R01	127	Carissa Lao	09:35	Lect. Hall B-206
K03	82	Clare Leahy	09:10	Lect. Hall B-206
O12	108	Lakhena Leang	1:45	Lect. Hall B-206
R04	128	Hankyul Lee	08:45	A-149
A04	36	Jenny Lee	12:55	A-155
O13	108	Jessica Lee	2:10	A-151
F06	67	Mack Lee	10:50	A-133
E04	61	Ryan Leemans	2:10	A-119
Q03	126	Sophie Legan	10:25	Lect. Hall B-206
F07	68	Arthur Li	1:45	A-149
M05	88	Evan Li	1:45	B-110
C18	52	Grace Li	2:10	A-131
F08	68	Jingfei Li	11:15	A-151
O14	109	Judy Li	08:45	A-147
P04	119	Kevin Li	09:35	A-131
P03	118	Kevin Li	09:10	A-131
N14	97	Shelly Li	10:00	A-115
B03	41	Claire Liang	1:20	A-113
P05	119	Emily Lindgren	1:20	A-151

O15	110	Emily Ling	2:10	Lect. Hall B-206
K04	82	David Lisk	10:50	A-119
G03	71	Christine Liu	09:10	A-149
N04	91	Gina Liu	08:45	A-115
C19	52	Lily Lou	1:45	Acad. Pit A-138
F03	66	Kristen Mancini	08:45	A-135
K06	83	Earl Justin Mangulabnan	2:10	A-149
C20	53	Anuj Marathe	2:10	A-115
R05	129	Anthony John Marquez	1:20	A-149
O16	111	Sarah Martin	12:30	Lect. Hall B-206
E05	61	John McGuire	12:30	A-151
K01	80	Marco Medina	2:10	B-133
B04	41	Aalap Mehta	10:00	Kids Inst. E-115
J03	79	Anna Melberg	10:25	A-149
Q03	126	Cristina Menchaca	10:25	Lect. Hall B-206
O11	107	Jackson Michuda	1:45	B-133
R05	129	Erma Mladenova	1:20	A-149
I06	76	Valerie Moore	08:45	Kids Inst. E-115
Q02	125	Colette Moos	2:10	Kids Inst. E-115
C21	53	Shruthi Mothkur	2:10	A-135
A05	37	Philip Nebres	09:10	A-115
R03	128	Gregory O'Bannon	10:00	Lect. Hall B-206
L02	86	Jameson O'Reilly	10:00	A-149
R06	129	Karen Olowu	08:45	Lect. Hall B-206
K07	84	Anthony Ortiz	1:45	A-147
C16	51	Nitya Pariti	09:10	A-151
O05	103	Deborah Park	10:25	Acad. Pit A-138
F08	68	Hyun Bin Park	11:15	A-151
O07	104	Matthew Park	1:20	B-133
C07	46	Nahee Park	11:15	B-108
N12	96	Monica Patel	12:55	B-110
A06	37	Ruchi Patel	11:15	A-113
O17	111	Shivani Patel	12:30	B-108
N15	97	Viveka Patel	2:10	A-133
N01	90	Jenson Phung	10:00	A-147
A02	35	Atene Poskute	11:15	Acad. Pit A-138
P06	120	Sagar Punhani	1:20	A-121
O04	103	Brianna Pusey	12:30	Kids Inst. E-115
Q04	126	June Qian	09:35	B-110
P07	120	Benjamin Rabe	10:00	B-110
G03	71	Ashley Radee	09:10	A-149

O18	112	Yvette Ramirez	1:45	A-133
O19	112	Vignesh Ravi	10:50	A-113
N16	98	Joseph Reda	12:55	A-115
N17	98	Sankeerth Reddy	10:25	B-116
O12	108	Xueyang Ren	1:45	Lect. Hall B-206
E06	62	Daniel Rosenthal	11:15	A-121
F09	69	Pratyush Rustagi	1:45	A-155
N18	99	Hannah Sambor	10:25	B-110
K08	84	Shreya Santhanam	09:10	A-147
N01	90	Shreya Santhanam	10:00	A-147
R07	130	Arjun Sarode	09:35	B-116
E07	63	Justin Sass	12:55	A-113
B05	42	Sreyesh Satpathy	10:50	A-131
I07	76	Sreyesh Satpathy	11:15	A-131
A07	38	Sajishnu Savya	10:50	Acad. Pit A-138
F10	69	Andrew Schell	11:15	Lect. Hall B-206
P08	121	Robert Schurz	10:25	A-115
J04	80	Addison Schwaller	2:10	A-147
O20	113	Devin Scott	09:35	A-121
E04	61	Travis Scott	2:10	A-119
N19	99	Frances Seo	11:15	A-135
P09	121	Abhishek Sethi	1:45	B-108
O21	113	Carrie Sha	09:10	A-121
N17	98	Sunny Shah	10:25	B-116
C22	54	Shreya Shanker	12:30	A-131
P10	122	Woohyun Shin	08:45	A-131
P03	118	Woohyun Shin	09:10	A-131
E08	64	Navika Shukla	1:45	A-113
O22	114	Medha Singh	11:15	A-155
M06	89	Suraj Sinha	1:20	Kids Inst. E-115
N20	100	Ross Skelly	10:25	B-108
O23	114	Vimig Socrates	1:20	A-147
O24	115	Saigopal Somasundaram	08:45	B-133
C23	54	Nathan Suck	2:10	A-113
C24	55	Hannah Swerbenski	10:25	A-121
N21	100	Sai Talluru	10:00	B-133
C25	55	Arjun Tambe	08:45	A-121
C26	56	Steven Tan	1:45	Kids Inst. E-115
P11	122	Lee Tang	09:10	B-116
M04	88	Matthew Tennenhouse	09:35	Kids Inst. E-115
O22	114	Lynette To	11:15	A-155

N22	101	Shruti Topudurti	10:50	Kids Inst. E-115
E05	61	Jeffrey Tucker	12:30	A-151
C27	56	Jeremy Tyszkiewicz	1:20	Acad. Pit A-138
Q02	125	Tony Vadakumchery	2:10	Kids Inst. E-115
O24	115	Sarah Valentine	08:45	B-133
P12	123	Lia Vallina	12:55	Kids Inst. E-115
C13	49	Rohan Verma	11:15	B-133
G04	72	Phuong Vo	09:35	A-149
D02	59	Brennan Wakey	08:45	A-133
K09	85	Samuel Walder	09:35	Acad. Pit A-138
I08	77	Stephanie Wang	08:45	A-119
I09	77	Stephanie Wang	09:10	A-119
C11	48	Yuanhao Wang	09:35	A-151
C19	52	Ciara Wardlow	1:45	Acad. Pit A-138
G03	71	Heidi Warning	09:10	A-149
A07	38	Joseph Weinrich	10:50	Acad. Pit A-138
B06	42	Elizabeth Weiss	10:50	B-133
R06	129	Isabella West	08:45	Lect. Hall B-206
O18	112	Michelle Wiebe	1:45	A-133
C06	45	Mateusz Wojtaszek	10:00	A-135
C28	57	Johnny Wu	10:00	B-108
P13	123	Joshua Wu	10:00	A-113
O25	116	Summer Wu	1:45	A-121
P14	124	William Xu	10:25	Kids Inst. E-115
A08	38	Shohei Yamakawa	2:10	B-110
P15	124	Oleksandr Yarema	10:25	A-131
O15	110	Hye Jean Yoon	2:10	Lect. Hall B-206
E09	64	Aaron Yu	08:45	B-110
C17	51	Kenneth Yun	10:50	B-108
K06	83	Scott Zelman	2:10	A-149
N22	101	Selam Zenebe-Gete	10:50	Kids Inst. E-115
F11	70	Michael Zeng	09:35	A-133
C29	58	Luke Zhan	10:25	A-119
O20	113	Jennifer Zhang	09:35	A-121
I10	78	Kevin Zhang	12:55	B-133
E07	63	Yifu Zhang	12:55	A-113
O26	116	Ellen Zhao	1:20	B-108
O10	106	Amy Zhu	09:35	A-113



REST ROOMS

