

1989
1990
1991
1992
1993
1994
1995
1996

IMSAloquium

STUDENT INVESTIGATION SHOWCASE



20th Anniversary April 30, 2008

www.imsa.edu

IMSAloquium

STUDENT INVESTIGATION SHOWCASE

April 2008

Dear IMSA Friends:

Marking its twentieth year, IMSA's Student Inquiry and Research Program (SIR) is a powerful expression of the Academy's mission, "to ignite and nurture creative ethical minds that advance the human condition." SIR enables students to pursue solutions to problems that challenge our global community through partnerships with distinguished professionals at colleges and universities, research institutions, businesses, and museums.

Through SIR, our students actively pursue answers to significant questions and solutions to complex problems. Working with world-class scholars and advisors, students have contributed to advances in such fields as the diagnosis of colon cancer, the One-Laptop-Per-Child initiative, using nanotechnology to detect hydrogen gas leakage from fuel cells, the rehabilitation of stroke patients, and the narrative abilities of brain-injured children. This work is shared through presentations, publications, and collaborations with other students, scholars, artists, and inventors throughout the world.

Through innovative programs, such as SIR, IMSA strives to stimulate excellence in mathematics and science teaching and learning across Illinois and beyond. We are assisting the State's policymakers and business leaders in developing "next generation" talent and leadership in science, technology, engineering, and mathematics. Some evidence of our students' excellence and IMSA's innovations you will find within this proceedings book of our twentieth IMSAloquium

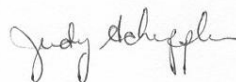
Now in its third decade, IMSA has nurtured extraordinary young investigators who exemplify a tradition of excellence. We aspire to become "the world's leading teaching and learning laboratory for imagination and inquiry." We set high expectations for our students, and we believe that you will find that IMSA students far exceed these expectations for accomplishments and contributions to society. They are well-prepared to solve the challenges that we will face in the future.

Thank you for celebrating our students' successes with us!

Sincerely,



Glenn "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

Twentieth Annual IMSAloquium

April 30, 2008

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Inside Back Cover – IMSA Map with Room Locations Highlighted

Cover and IMSAloquium designers are Jean Bigger and Irene Norton, IMSA staff members.

The background image of the cover is a composite and manipulation of three images found from:

SemiAntics

<http://www.semiantics.com/?p=65&h=364&w=485&sz=20&hl=en&start=639&tbnid=DUujr4XkbopEiM:&tbnh=>

Sulekha

<http://gauravbrills.sulekha.com/blog/post/2007/12/should-i-still-be-reading-books.htm>

Gentoo Linux

http://dev.gentoo.org/~dberkholz/wallpaper/shore_of_the_fractal_sea-1600.jpg

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

Twenty 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. The First Annual Presentation Day was held April 24, 1989, and you can view that program in the following pages. It was an auspicious start with then charter member and now English faculty member Dr. Michael Hancock's investigation "Baseball's Reserved Seat in the American Psyche" and Rowan Lockwood's Westinghouse finalist investigation "Pterosaurian Terrestrial Locomotion," among the program.

Since its inception with seven students, SIR has grown into a program that encompasses all disciplines and participation by nearly three-quarters of each graduating class. 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

- *Alpha Epsilon Newsletter*
- *Biology of Reproduction*
- *Ceramic Engineering Science*
- *Ceramic Transactions*
- *El Conquistador (newspaper)*
- *Intelligent Engineering Systems Through Artificial Neural Networks*
- *Journal of Dispersion Science and Technology*
- *Learning and Leading with Technology*
- *Meteoritics and Planetary Science*
- *Monaldi Archives of Chest Disease*
- *NATO Science Series*
- *Nature*
- *Neuroscience Research Communications*
- *Physics in Medicine and Biology*
- *The Science Teacher*
- *Biographies of the Citizens of Lee County Illinois: Through the Years*
- *NCSSMST Journal*
- *Traditions, Transitions, and Technologies - Themes in Southwestern Archaeology*

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.

"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).

Presentations

- Adventures of the Mind Conference
- American Academy of Pediatrics
- Junior Academy of Science at AAAS (107 students)
- American Chemical Society
- American Psychiatric Association
- American Society of Cell Biology
- American Society of Echocardiography
- American Society of Microbiology
- 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
- Great Lakes History Conference
- History of the Atomic Age - Chicago Historical Society
- IEEE Engineering in Medicine and Biology Science Conference
- IEEE Nuclear Science Symposium
- Illinois Section of the Mathematics Association
- International Signal Processing Conference
- Junior Science and Humanities Symposium
- Meteorological Society Meeting
- Midwest Drosophilae Conference,
- National African American Studies Conference
- National Association of Biology Teachers
- National Conference on Undergraduate Research (36 students)
- Native American Studies Conference
- NATO Network of Excellence
- NCSSSMST Student Research Symposium (42 students)
- Nasset Research Forum
- Pediatric Society
- Rush University Research Forum
- Sakharov Readings (16 students)
- Society for Integrative and Comparative Biology
- World Conference on Science
- Young Women in Science and Technology

Competitions

- Jack Kavanagh Memorial Youth Baseball Research Award (Society for American Baseball Research)
- Junior Science and Humanities Symposium
- National History Day Competition
- Neuroscience Research Prize
- Neuroscience Creativity Prize
- Science Talent Search
 - 28 semi-finalists and 11 finalists since 1989
 - Finalists have placed first (1993), fifth (1998), third (1999), and second and sixth (2005)
- Siemens Westinghouse (established 1998-99)
 - 16 regional semi-finalists and 1 Finalist
- Young Epidemiology Scholars

Remember that the
FIRST ANNUAL IMSA PRESENTATION DAY
will take place next MONDAY

April 24, 1989

Attached is a schedule of the times and locations of the presentations.

All faculty and students are expected to attend at least one of the sessions. At the end of her talk, Rowan Lockwood will describe some of her experiences as a Westinghouse finalist.

There will be a short Awards Ceremony at 11:00 AM in the Auditorium. After that ceremony the presenters will be available for questions that couldn't be answered during the regular sessions.

**First Annual IMSA Presentation Day
Monday, April 24, 1989**

Session AUD 1

New Ideas

9:00 – 9:55

9:00 – 9:15 A1 **Recent Reports of Cold Fusion**

Patrick LaMaster, IMSA

On March 23, 1989 two Chemists from the University of Utah held a press conference to announce their discovery of a room temperature fusion process. Scientists from around the world have been racing to verify the results of what some have proclaimed as one of the greatest discoveries of our time. This presentation will look at the findings put forth in the Utah fusion papers. In addition, recent verification reports as well as future implications of cool fusion will be discussed.

9:20 – 9:35 B1 **Beyond TCAS: Computer Assisted Air Traffic Control**

Jeffrey Young, IMSA

A working model of a computer-based system for assisting air traffic control has been designed and constructed. The model includes computer programs to pre-process the information necessary for air traffic control. The model did not operate faster than the present airspace control system. The author believes the model is more efficient than existing systems.

9:40 – 9:55 C1 **A Quantitative Description of Fluid Flow on the Molecular Level**

Mbuyi and Sanza Kazadi

A theoretical analysis of the boundary layer in laminar flow has been done. Basic mechanical principles are applied to the interaction between moving particles and a stationary surface. Key concepts used are the mean free path for the particles and completely (or partially) elastic collisions. Predictions are made for the pressure variation in the fluid, the drag force produced, and the velocity profile of the flow.

**First Annual IMSA Presentation Day
Monday, April 24, 1989**

Session AUD 2
Life Science Papers
Auditorium
10:00 – 10:55

10:00 – 10:20 A2 **Ionic Interactions in the Mechanism of the (Na⁺ + K⁺) ATPase Pump**

Mehmet Guler, IMSA

It is hypothesized that the negatively charged phospholipids (phosphatidylserine and phosphatidylinositol) which are found in the inner layer of the cell membranes of animal species, produce an electric field that affects the mobility of Na⁺ and K⁺ differently. It is believed that this difference in behavior which is caused by the electric field enables the (Na⁺ + K⁺)-ATPase to distinguish one cation from the other and consistently transport Na⁺ outward and K⁺ inward.

To determine the effects of an electric field on the mobility of Na⁺ and K⁺ the diffusion rates of NaCl and KCl are measured in a model cell both when an electric field is and is not present. In result, it is observed that while the diffusion rate of both Na⁺/Cl⁻(aq) and K⁺/Cl⁻(aq) are equal without the electric field, the diffusion rate of Na⁺/Cl⁻(aq) is greater than the diffusion rate of K⁺/Cl⁻(aq) in the presence of the electric field.

It is concluded that this difference in the diffusion rate is most likely due to the different effects of the electric field on the mobility of Na⁺ and K⁺. In light of these results, it is further believed that this phenomenon can be applied to a real cell, and with this, some unknown aspects of the mechanism of the (Na⁺ + K⁺)-ATPase pump can be explained.

10:25 – 10:55 B2 **Pterosaurian Terrestrial Locomotion**

Rowan Lockwood, IMSA

Controversy exists over pterosaurian terrestrial locomotion. This study examines a critical activity, terrestrial take-off, in Pteranodon ingens, a larger pterosaur. The ground clearance height is calculated, then the force, energy, and muscle mass required to generate a leap to this height. These results are comparable with known characteristics of Pteranodon and a comparable, the albatross Diomedea exulans. This methodology, matching a muscle requirement to a stimulated effort, may be applied in other biomechanical simulations.

**First Annual IMSA Presentation Day
Monday, April 24, 1989**

Session NLH 1
History Papers
New Lecture Hall
9:00 – 9:55

9:00 – 9:15 A1 **Migration in the Nineteenth Century Rural Denmark:
The Case of Magleby Parish**

Christian Nokkentved, IMSA

In the 1800s, Europeans significantly expanded their migratory habits. A detailed analysis of local parish records reveal something of the nature of those migration patterns and their changes over time, as they relate to one locality. People moved in what might be called a migratory web; i.e. while some left, others arrived, and yet others moved about in the parish. The most significant changes between the 1830s and 1901 were the number of people crossing the parish boundary who a) came from or went to cities, and b) travelled long distances. In both cases there was a significant increase over time. A comparison of these results with the few other studies available suggest that these phenomena are not unique to Magleby Parish.

9:20 – 9:35 B1 **Liberal Dove Ideological Opposition to the Vietnam War:
Were They Opposing the War for the Wrong Reason?
A Revisionist Perspective**

Kenneth Guest, IMSA

This paper is concerned with historiographical debate over the origins and nature of American intervention in Southeast Asia. The Cardinal Revisionist tenet holds that Democratic Liberal Doves eventually called for alterations in Vietnam policy not because existing Vietnam policy was inherently immoral and violated the very best characteristics and beliefs in American society but because the Vietnamese model of interventionist foreign policy was too costly and ineffective. By examining the comments and analysis of the Liberal Dove opposition which finally urged major alterations in Vietnam policy; perhaps; it will be possible to test more accurately the basic Revisionist historiographical arguments, to reach a better understanding of the nature and purpose of the Liberal Dove opposition to the Vietnam War, and to contemplate what effects the nature of Liberal Dove opposition to the Vietnam War will have on future American foreign policy.

**First Annual IMSA Presentation Day
Monday, April 24, 1989**

Session NLH 1 continued

9:40 – 9:55 C1 **Baseball's Reserved Seat in the American Psyche**

Michael Hancock, IMSA

A study of baseball and its place in the mythos of America was conducted in an effort to discover why baseball is so important to so many people. A survey of baseball fiction and a review of academic musings on the game provided the background for a thorough examination of the sport known as America's "National Pastime." Traditional explanations of baseball's importance were rejected as being incomplete. However, more contemporary ideas, in conjunction with general views of the significance of sports in society, provide a more adequate interpretation of baseball and its meaning to millions of Americans.

**First Annual IMSA Presentation Day
Monday, April 24, 1989**

Session NHL 2
Physics Papers
New Lecture Hall
10:00 – 10:55

10:00 – 10:20 A2 **An Analysis of the Contact Bounce**

Alexander Lurie, Evanston Township High School

An investigation was done to analyze the phenomenon of the contact bounce of a mass-spring system. A simple model was created using two equal point masses that approach a hard wall. The masses are joined by a spring of constant K_2 , while a spring of constant K_1 is attached to a mass that approaches the wall. For certain values of $\beta(K_1/K_2)$, the system rebounded and hit the wall a second time, producing a “double hit.” Solving an eigenvalue problem, the critical value of β for which the double hit occurred was found to be 3.89. More complex mass-spring systems were also investigated.

10:25 – 10:55 B2 **The Design and Testing of Aerofoils in a Wind Tunnel**

Gina Martyn, IMSA

I constructed a low-speed wind tunnel and used it to test the lift, drag, streamline, and stability of five shapes. Finding the best general form, I then designed four other aerofoil shapes based upon streamline using a computer program designed by Mr. J. Way. I created models using these four shapes and tested these four shapes and tested these aerofoils for lift, drag, and streamline in my wind tunnel. As a result, I was able to find a highly effective aerofoil. Construction of the wind tunnel and principles of aerodynamics will be discussed in the presentation.

Session AUD 3
Awards Ceremony
Auditorium
11:00 – 11:15

You can ask questions of the presenters at the end of the awards ceremony.

2007-2008 Student Recognition

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

Hosted By

Dr. Leon Lederman, Nobel Laureate and IMSA Resident Scholar

And

Dr. Glenn “Max” McGee, IMSA President

Megan Abel: An Epicardial Analysis in the Late Gestational Heart

Advisor: Dr. Robert Dettman, Northwestern University Feinburg School of Medicine
3rd International Students' Science Fair (ISSF) 2007

Dimple Adatia: The Role of Histology in Response to Chemotherapy and Impact of Radiation on Outcome in Pediatric and Adolescent Hodgkin's Lymphoma

Advisor: Dr. James Nachman, University of Chicago
*Illinois Junior Academy of Sciences Competitor**

Perry Bradford: Comparison of DNA in Large Breed Bichons With and Without Hip Dysplasia

Advisor: Dr. Susan Styer, Illinois Mathematics and Science Academy
Academic, Cultural, Technological and Scientific Olympics (ACT-SO) Gold Medal Winner and Silver Medal in biology at the national competition

Steven Cai: Studies of the Structures of the Channeled Si and Si/Ge Stressors in a 30-nm Field-Effect Transistor Using Synchrotron X-Ray Diffraction Data System Modeling

Advisor: Dr. Jin Wang, Argonne National Laboratory
Siemens Competition semi-finalist, Intel Science Talent Search semi-finalist

Hyunjii (Justina) Cho: The Detection of Differences Between Normal and Cancerous Stem Cells Through Analysis of Morphology, Gene Expression, And Effects of Dichloracetate

Advisors: Dr. Morris Kletzel and Mrs. Marie Olszewski, Children's Memorial Hospital
*Illinois Junior Academy of Sciences Competitor**

Lindsey Choi: Targeted Fluconazole Prophylaxis for the Prevention of Systematic Candidemia in Extremely Low Birth Weight Infants

Advisors: Dr. Brett Galley and Dr. Jonathan Muraskas, Loyola University
Japan RITS

Yangbo Du: Promoting Bio-Ethanol in the United States by Incorporating Lessons from Brazil's National Alcohol Program

Advisor: Dr. Joshua Linn, University of Illinois and Dr. R. Stephen Berry, University of Chicago

Published in: *National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology Journal*. Fall 2007. 13(1): 12-17.

Zexi J. Fang: Hydrogen Sensors Based on Ultra-thin Palladium Nanobead Arrays on Porous Anodic Aluminum Oxide (AAO) Substrates

Advisor: Dr. Zhili Xiao, Argonne National Laboratory
Intel Science Talent Search semi-finalist

Frances Mei Hardin: Weak Lensing Mass Estimates of Low Redshift Clusters of Galaxies

Advisors: Dr. James Annis and Dr. Albert Stebbins, Fermi National Accelerator Laboratory
*Illinois Junior Academy of Sciences Competitor**

Forrest Iandola: Calculating the Accuracy of the Beam Position Monitors in a Fermilab Electron Accelerator

Advisors: Dr. Michael Syphers and Dr. Raymond Filler III, Fermi National Accelerator Laboratory
*Illinois Junior Academy of Sciences Competitor**

Sushma Kola: Overexpression of Aquaporin-1 in Non-Small Cell Lung Cancer

Advisor: Dr. Anjana V. Yeldandi, Northwestern University Feinberg School of Medicine
*Illinois Junior Academy of Sciences Competitor**, 2008 sanofi-aventis International BioGENEius Challenge: *Illinois State finalist*

Kelsey Lawhorn: Weak Lensing Mass Estimates of Low Redshift Clusters of Galaxies

Advisors: Dr. James Annis and Dr. Albert Stebbins, Fermi National Accelerator Laboratory
*Illinois Junior Academy of Sciences Competitor**

Kristen Lee: The Role of Protein Kinase C in the Degradation of the G-Protein Coupled Receptor CXCR4

Advisor: Dr. Adriano Marchese, Loyola University
*Illinois Junior Academy of Sciences Competitor**

Jimmy Liu: The Detection of Differences Between Normal and Cancerous Stem Cells Through Analysis of Morphology, Gene Expression, and Effects of Dichloroacetate

Advisors: Dr. Morris Kletzel and Mrs. Marie Olszewski, Children's Memorial Hospital
*Illinois Junior Academy of Sciences Competitor**

Jonathan Loucks: An Analysis of Illinois Public Schools: The Effects of Different Socioeconomic and Environmental Factors on a School's Ability to Meet or Exceed State Standards

Advisor: Mr. Joe Traina, Illinois Mathematics and Science Academy
*Illinois Junior Academy of Sciences Competitor**

Anita Mehta: Exploring the Efficiency of the MINOS Experiment in the Far Detector

Advisor: Dr. Niki Saoulidou, Fermi National Accelerator Laboratory
Japan RITS

Vineet Mohanty: Evaluation of Ultrasensitive p24 Antigen Assay as an Alternative to Standard Viral Load and Antigen Assays in Diagnosis and Patient Treatment Monitoring

Advisor: Mr. Bill Kabat, Children's Memorial Hospital
3rd International Students' Science Fair (ISSF) 2007: Second Honorary Mention (5th) in Oral Presentation in Biology

Jagannath (Sam) Nayak: Magnetic Nanostructures for Biomedicine

Advisor: Dr. Vinayak Dravid, Northwestern University McCormick School of Engineering
Siemens Competition semi-finalist, Intel Science Talent Search semi-finalist

Birce Onal: Identification of a Gene Responsible for Membrane Resistance in *Escherichia Coli*

Advisor: Dr. Eric Vimr, University of Illinois at Urbana/Champaign
Siemens Competition semi-finalist

Karan P. Patel: Angiogenic Inhibitors and Inhibitors of Histone Deacetylases - A New Way to Block Tumor Growth and Angiogenesis?

Advisor: Dr. Olga Volpert, Northwestern University
3rd International Students' Science Fair (ISSF) 2007: second place oral presentation in biology, third place (overall) in poster presentation

Sophia Pilipchuk: The Effect of Epigallocatechin-3-Gallate (EGCG), a Green Tea Polyphenol, on HeLa Cell Viability and Proliferation

Advisor: Dr. Don Dosch, Illinois Mathematics and Science Academy
Junior Sciences and Humanities Symposium

Shailee Shah: Dietary Implementation of Flax Seed/Omega-3 Fatty Acids in Ovarian Cancer in the *Gallus Domesticus* Laying Hen

Advisor: Dr. Dale Buchanan Hales, University of Illinois at Chicago
*Illinois Junior Academy of Sciences Competitor**

Jianning (Jenny) Shao: A Novel Nonlinear Secret Encryption Scheme Generates Escalating Entropy

Advisor: Dr. Bin Shao

*Junior Sciences and Humanities Symposium: regional finalist; Illinois Junior Academy of Sciences Competitor**

Sarah Shareef: The Response of Oligodendrocytes to Normal Appearing White Matter from Multiple Sclerosis and Control Patients-A Study of the Early Pathology of Multiple Sclerosis

Advisor: Dr. Sara Becker-Catania, Edwards Hines VA Hospital

Siemens Competition semi-finalist, Junior Sciences and Humanities Symposium: regional finalist

Eric Shyu: On a Number-Hiding Game

Advisor: Dr. Mark Fischler, Fermi National Accelerator Laboratory

*Illinois Junior Academy of Sciences Competitor**

Sonny Song: The Analysis and Implementation of Live Cell Imaging in the Study of Interactions Between LMP4 and Actin Filament

Advisor: Dr. Teng-Leong Chew, Northwestern University Feinberg School of Medicine
Japan RITS

Anisha Vyas: Using Spectral Absorption Information to Identify Tumors

Advisor: Dr. Xu Li, Northwestern University

Illinois Junior Academy of Sciences Competitor, 2008 sanofi-aventis International BioGENEius Challenge: Illinois State finalist*

Evelyn Wang: A Test of the Hypothesis That Transposon Exclusion Zones (TEZs) in Mammalian Genomes are Associated with Haplo-insufficient Genes

Advisor: Dr. Patrick Venta, Michigan State University

Siemens Competition semi-finalist, Junior Sciences and Humanities Symposium: second place in regional competition, advancing to national competition

Anthony Yunker: Weak Lensing Mass Estimates of Low Redshift Clusters of Galaxies

Advisor: Dr. James Annis, Fermi National Accelerator Laboratory

*Illinois Junior Academy of Sciences Competitor**

Emily Zhao: Correlation Mapping: An fMRI Analysis of the Neural Response to Visual Stimuli

Advisor: Johannes Haushofer, Harvard University

Intel Science Talent Search semi-finalist, Junior Sciences and Humanities Symposium

* Illinois Junior Academy of Sciences Regional competition was held April 5, after the IMSAloquium abstract book went to press. State competition is May 2 and 3.

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

IMSALOQUIUM:
Student Investigation Showcase
April 30, 2008

SCHEDULE OF SESSIONS

8:00 - 9:00 a.m.	Poster Session
9:10 - 9:25 a.m.	IMSALOQUIUM Session 1
9:35 - 9:50 a.m.	IMSALOQUIUM Session 2
10:00 - 10:15 a.m.	IMSALOQUIUM Session 3
10:25 - 10:40 a.m.	IMSALOQUIUM Session 4
10:50 - 11:05 a.m.	IMSALOQUIUM Session 5
11:15 - 11:30 a.m.	IMSALOQUIUM Session 6
11:30 - 12:30 p.m.	Lunch
12:30 - 12:45 p.m.	IMSALOQUIUM Session 7
12:55 - 1:10 p.m.	IMSALOQUIUM Session 8
1:20 - 1:35 p.m.	IMSALOQUIUM Session 9
1:45 - 2:00 p.m.	IMSALOQUIUM Session 10
2:10 - 2:25 p.m.	IMSALOQUIUM Session 11

IMS Aloquium Poster Session

Biochemistry

- A01 Brian Chang
Jessina Thomas
- A02 Sena Dzakuma
- A03 Jingsi Fan
- A04 Ankit Jain
Yousif Kelaita
- A05 Philip Kuo
- A06 Yize Leng
- A07 Akash Moradia
- A08 Arjun Nayini
Grant Rotskoff
- A09 Bani Saluja
- A10 Nicholas Rock
Isaiah Tan

Bioengineering

- B01 Frederick Damen
- B02 Hendrik Dewald
- B03 Joseph Ou
Sonny Song
- B04 Jasmine Shah
- B05 Alisha Vimawala

Biology

- C01 Megan Abel
Lindsey Choi
- C02 Pedro Aguirre
- C03 Luis Carbajal
- C04 Hyun Cho
Jimmy Liu
- C05 Catherine Crawford
- C06 Bryan Denig
Anastasia Rahlin
- C07 Jenny Fang
Seung Heo
- C08 Anamaria Filipac
- C09 Paoula Gueorguieva
- C10 Nathaniel Hausfater
- C11 Elizabeth Ikejimba
- C12 Yaseen Jamal
Karthik Vantakala
- C13 Sonali Jayakar
- C14 Janel Jin
- C15 Kristen Lee
- C16 Ranjani Logaraj
- C17 Birce Onal
- C18 Birce Onal
- C19 Ravi Pilla
- C20 Shailee Shah
- C21 Jianning Shao
- C22 Edward Song

Biology continued

C23 Shobha Topgi
C24 Thiran Udawatta
C25 Ruijie Zhang
C26 Jiabo Zheng

Business

D01 Elliot Margul
D02 Margaret Tu

Chemistry

E01 Sena Dzakuma
E02 Andrew Groesch
E03 Yifei Huang
E04 Andrew Nelson
E05 Erin Talbot
E06 Ruhiyyeh Turner

Computer Science

F01 Katie Cruppenink
F02 Alexander Drummond
Kyle Hanson
F03 Justin Johnson
Ilya Nepomnyashchiy
Jason Rock
F04 Cathy Li
F05 Xuxuan Liu
F06 Guy Macarol
F07 Jonathon Ronchetti

Economics

G01 Ryan Angelotti
Ryan Wang
G02 Jeffery Ding
Bo Shi
G03 Yangbo Du
G04 Michael Paik
G05 Ellen Song
G06 Mark Xue

Education

H01 Theodore Atwood
Brian Flynn
H02 Naomi Morphis
H03 Janelle Peifer
H04 Cari Peterson
H05 Valerie Young

Engineering

I01	Cameron Breedlove Jessica Durden Jae Kim Adam Leemans Bohao Liu Shaine Strullmyer
I02	Caitlin Bunt Ricardo Gonzalez Ekaterina Kononov Scott Page
I03	Steven Cai
I04	Roy Fisher
I05	Ray Gu Sammy Nguyen
I06	Yoonjung Koh Ariel Liu
I07	Jacob Maloney
I08	Martina Pillay
I09	Priyanka Prakash
I10	Evan Rodrigues
I11	Anisha Vyas
I12	Brandon Zhang
I13	Terence Zhao

English

J01	Jennifer Byers
J02	Jennifer McDormand Meaghan Pachay
J03	Kyle Schirmann

Fine Arts

K01	Rachel Banke
K02	Kayla Campbell
K03	Alex Ma Alan Shen Timothy Truong
K04	Lisa Peterson
K05	Patricia Whittaker

History

L01	Mari Crook
L02	Lucas Delort
L03	Tianyu Du Alyssa Winans
L04	Caitlin Guerra
L05	Bethliz Irizarry Troy Nelson
L06	Shawna Roberts
L07	Sanat Bhole Luis Carbajal Nina Gnedin Thomas Vandiver

Law

- M01 Sanat Bhole
M02 Tianyin Luo
Gokila Pillai
M03 Sylwia Matlosz
Ashima Sarup
M04 Colin Phillips

Mathematics

- N01 Je-ok Choi
N02 You Na Oh
N03 Eric Shyu
N04 Justin Troyka

Medicine

- O01 Dimple Adatia
O02 Oluwakemi Aladesuyi Arogundade
O03 Neelam Balasubramanian
O04 Jorge Jeria
Arika Verma
O05 Sushma Kola
O06 Bob Lee
O07 Yue Lu
O08 Anita Mehta
O09 Vineet Mohanty
O10 Solomon Nittala
Gaurav Singh
O11 Karan Patel
O12 Suganya Rajendran
O13 Hannah Reiser
Sarah Trevor
O14 Sarah Rokosh
O15 Vincent Rossi
O16 Sarah Shareef
O17 Hyun Soo Sheen
O18 Jisun Yoo
O19 Eva Yuan

Neurobiology

- P01 Audrey Auyeung
Anjolie Gang
Anil Vaitla
P02 Perry Bradford
P03 Mamatha Challa
P04 Hannah Dada
Velin Tchalakov
P05 Andrew Gentile
Monica Kao
P06 Nina Gnedin
P07 Vidya Govind-Thomas
Anne Pipathsouk
P08 Tyce Herrman
Ellen Ryan
P09 Kevin Lam
P10 Ernestina Perez
Robert Till

Neurobiology continued

P11 Sophia Pilipchuk
P12 Jonathon Schwarzbauer
P13 Katherine Tu
P14 Milan Udawatta

Physics

Q01 Stephanie Brandt
Q02 Matthew Castillon
Travis Mui
Q03 Tiernan Evans
Q04 Forrest Iandola
Sandeep Paruchuri
Q05 Benjamin Ray
Q06 Francis Walsh

Psychology

R01 Kevin Crews
R02 Crystal Croyl
Kenneth Higa
Sarah Lightfoot Vidal
R03 Hilary Dietz
R04 Chelsea Fu
R05 Sarah Kang
R06 Tatiana Lakshmanan
R07 Henry Liang
Laura Thompson
R08 Ranait O'Connor
R09 Seth Pree
R10 Karen Song
R11 Sabrina Song
R12 Yuchen D Sun
R13 Vaishali Umrikar
R14 Robert Washington
R15 Feiyang Ye
R16 Jenny Zhang

Social Science

S01 Amy Allen
S02 Erika Bongen
S03 Kelsey Gee
Sammy Nammari
S04 Christian Gines
S05 Eric Hultgren
Cody Morrow
S06 Catrina Kim
S07 Jonathan Koch
Gouthami Rao
S08 Donald Lee-Brown
S09 Josue Pernillo
Gustavo Ulloa
S10 Michael Reeks
S11 Tabitha Mei Walquist
S12 Jing Zhang

Space Science

T01 Christopher Gropp
T02 Frances Hardin
Kelsey Lawhorn
Anthony Yunker
T03 Sapna Patel
Jennifer Roderick
T04 Nathaniel Simpson

Theology

U01 Meredith Rhein
U02 Shuang Zhang

Schedule

9:10 - 9:25

Room	ID	
A-117	R11	Narrative Abilities in Children Sabrina Song, Ozlem Ece Demir, Susan Goldin-Meadow
A-119	C15	The Role of Protein Kinase C in the Degradation of the G-Protein Coupled Receptor CXCR4 Kristen Lee, Adriano Marchese
A-131	I09	The Purpose of the IL-131 Reconstruction Project in Lake County and its Social and Economic Impacts Priyanka Prakash, Derek Johnson, Donald Wittmer
A-133	G06	Trust Thy Neighbor But Not a Stranger Mark Xue, Min Sok Lee
A-135	C04	Detecting the Difference Between Normal and Cancerous Stem Cells Through Analysis of Morphology, Gene Expression, and Effects of Dichloroacetate (DCA). Hyun Cho, Jimmy Liu, Morris Kletzel, Marie Olszewski
A-147	E02	Zeolites and NOx Reduction Reactions Andrew Groesch, Randall Snurr
A-149	S08	Media's Role in the Present-Day United States: Beyond the News Donald Lee-Brown, Claiborne Skinner
A-151	T02	Weak Lensing Mass Estimates of Low Redshift Galaxy Clusters Frances Hardin, Kelsey Lawhorn, Anthony Yunker, James Annis, Donna Kubik, Jeffrey Kubo, Huan Lin, Albert Stebbins
A-155	L05	The Evolution of English Between Chaucer and Shakespeare Bethliz Irizarry, Troy Nelson, Margaret Cain
Acad. Pit A-138	U01	Comparison of Gender Role Beliefs Between IMSA and Non IMSA Christian Students Meredith Rhein, Grace Glass
B-110	C09	The Effect of Food Dyes and Acid/Base Indicators on Bacteria Paoula Gueorguieva, Donald Dosch, Susan Styer
B-116	C06	Zebrafish Embryogenesis: The Effects of Temperature on OTX2 and RALDH2 Bryan Denig, Anastasia Rahlin, F. Bryan Pickett
B-133	I03	Studies of the Structures of the Channeled Si and Si/Ge Stressors in a 30-nm Field-Effect Transistor Using Synchrotron X-ray Diffraction Data and System Modeling Steven Cai, Jin Wang
D-103	P04	Stroke Therapy at University of Illinois at Chicago Hannah Dada, Velin Tchalakov, Konstantin Slavin
D-107	I11	Using Spectral Absorption Readings to Identify Tumors Anisha Vyas, Xu Li

9:10 - 9:25 continued

- D-110 K02 **An Analysis of Gustav Mahler's First Symphony *The Titan***
Kayla Campbell, Steve Rings
- E-115 B01 **Correlation Between Cholesterol and Hyper-Contraction of Smooth Muscle During Asthma**
Frederick Damen, Irena Levitan

09:10 - 09:50 double time session

Room ID

- A-113 L02 **The Motives of a Master: Galileo's Quest for Truth**
Lucas Delort, Robert Kiely

9:35 - 9:50

Room ID

- A-119 R16 **Using Congenic Rats to Determine Genetic Contribution to Coping with Stress**
Jenny Zhang, Eva Redei
- A-131 B03 **The Practicality of Dry Laboratory Methodology and Geometric Modeling with a Mouse Brain in the Development of Drug Treatments for Neurodegenerative Diseases**
Joseph Ou, Sonny Song, Andreas Linninger, Anargyros Politis
- A-133 E06 **Nylon and Minimal Surfaces**
Ruhyyeh Turner, Vicki Burgholzer
- A-135 C03 **Real-Time Imaging of the Cellular Redistribution of HSP27-CFP and HSP70-GFP Fusion Proteins in Cardiovascular Smooth Muscle Cells to Assess Actin Cytoskeletal Remodulation**
Luis Carbajal, Jody Martin
- A-147 O01 **The Role of Histology in Response to Chemotherapy and Impact of Radiation on Outcome in Pediatric and Adolescent Hodgkin's Lymphoma**
Dimple Adatia, James Nachman
- A-149 O05 **Overexpression of Aquaporin-1 in Non-Small Cell Lung Cancer**
Sushma Kola, Anjana V. Yeldandi
- A-151 O02 **Sickle Cell Disease: The Association of Blood Platelet Count on the Severity of the Disease**
Oluwakemi Aladesuyi Arogundade, Robert Labotka
- A-155 G04 **The Relationship Between International Students Gaining Higher Educations in the United States of America and the Economic Development of Their Native Economies**
Michael Paik, Pradeep Chintagunta
- Acad. Pit A-138 S06 **A Long-Standing Debate: Race-Based Affirmative Action in College Admissions**
Catrina Kim, Jim Victory
- B-110 F07 **netLasso and High Speed Network Analysis**
Jonathon Ronchetti, Jason Leigh, Sungwon Nam

9:35 - 9:50 continued

Room	ID	
B-116	P05	Development of an α-Mannosidase 2A2 Based Gene Therapy for Glioblastoma Multiforme Andrew Gentile, Monica Kao, Roger Kroes
B-133	C17	Partial Differentiation of Adult Stem Cells into Neurons Upon Addition of β-Mercaptoethanol and Retinoic Acid Birce Onal, Donald Dosch
D-103	S03	Optimizing And Integrating An Ideal Leadership Development Program Kelsey Gee, Sammy Nammari, Robert Hernandez
D-107	I13	Wireless Location Based Road Tolling Application Terence Zhao, Mark Carlson, James Zhao
D-110	K01	The Conductors Baton: A Practical Approach to Orchestral Conducting Rachel Banke, James Priovolos
E-115	O18	Effects of Obesity and Race on Diabetes Mellitus Type 2 Jisun Yoo, Sowmya Anjur

9:35 – 10:15 double time session

A-117	G03	The Economic Costs of Deploying Fast Reactors in the United States as a Climate Change Mitigation Measure Yangbo Du, R. Stephen Berry
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10:00 - 10:15

A-113	S04	Sociology of the Internet Christian Gines, David Evenson
A-119	A02	Lanthanide Binding Protein Sena Dzakuma, Chuan He, Cathy Poor, Seraphine Wegner
A-131	I06	Life as an Architect Yoonjung Koh, Ariel Liu, Steve Vasilion
A-133	O17	Myxomatous Mitral Valve Repair: Development of an Algorithm to Quantify Mitral Leaflet Reduction for a Successful Repair Hyun Soo Sheen, Anna Huskin, Richard Lee
A-149	H05	Toys and Games Valerie Young, Claiborne Skinner
A-151	L04	The Effects of Fundamentalism on Women in Christianity and Islam Caitlin Guerra, Kathryn Kadel
A-155	S12	A Comparison of Healthcare Policies in China and Sweden Jing Zhang, Christian Nokkentved
Acad. Pit A-138	M02	The Death Penalty Worldwide Tianyin Luo, Gokila Pillai, Sandra Babcock
B-110	A10	The Effect of Lighting as a Stress Factor on Lipid Production in Filamentous Spirogyra Nicholas Rock, Isaiah Tan, Susan Styer, Joseph Traina

10:00 - 10:15 continued

Room	ID	
B-116	N02	History of Tangents From Apollonius to Cauchy (262 B.C.E. ~ Present) You Na Oh, Richard Wilders
B-133	P08	Moderate Ethanol Preconditioning of U373 Cells and Its Effects on Ethanol Tyce Herrman, Ellen Ryan, Michael Collins, Donald Dosch
Lect. Hall B-206	S10	Homosexuality and the Catholic Church Michael Reeks, Melissa Browning, Patricia Jung
D-103	H04	Motivation, Neuroscience, and the Brain Cari Peterson, Stephanie Marshall
D-107	S11	Web Searching Skills of the Average Young Adult Tabitha Mei Walquist, Eszter Hargittai
D-110	Q05	Searching for a Low-Mass Higgs Boson with Light Using Fermilab Collider Data Benjamin Ray, Robert Craig Group, Mike Lindgren
E-115	F06	Tabluntu: A Linux-Based Distribution for Tablet PC Users Guy Macarol, Scott Swanson

10:25 - 10:40

A-113	L01	Transformation of the Meat Industry with Disregard to the Environment Mari Crook, Jim Victory
A-119	R10	Determining How Ethanol in the Mother's Diet Affects Thyroid Status of the Fetus/Offspring Karen Song, Eva Redei, Laura Sittig
A-131	N01	On an Approach for Van der Waerden Numbers Je-ok Choi, Yon-Seo Kim
A-133	P03	Effects of Meditation on Sleep and Stress on Patients with Chronic Insomnia Mamatha Challa, Ramadevi Gourineni
A-135	O12	The NICHE (Non-Invasive Cardiac Hemodynamic Evaluation) Study Suganya Rajendran, Antony Kim
A-147	P09	Synaptic Targeting of Amyloid Beta Oligomers for Basis of Memory Loss and Alzheimer's Disease Kevin Lam, William Klein
A-151	J02	Coauthoring a Novella: Fighting for Saoirse Jennifer McDormand, Meaghan Pachay, Michael Casey
A-155	F05	Combining Computer Science with Biology: The Power of Perl Xuxuan Liu, Neil Smalheiser, Vetle Torvik
B-110	F01	Through Their Eyes: Using an Eye-Tracking System to Improve Focus Katie Cruppenink, Jason Leigh, Yiwen Sun

10:25 - 10:40 continued

Room	ID	
B-116	B04	Quantifying the Effect of Glucose on the Structure of Type IV Collagen Tissue Fibers of Diabetic Patients Jasmine Shah, Eric Brey
B-133	O08	Walking with a Robot: Correlation Between Post-Stroke Recovery Function and Training Performance Values Anita Mehta, David Brown
D-103	P07	Anosognosia and Alzheimer's Disease Vidya Govind-Thomas, Anne Pipathsouk, Eric Larson
D-107	I05	Sewage Off-Gas-Driven Fuel Cells to Stimulate Rural Electrification Ray Gu, Sammy Nguyen, Herek Clack
D-110	N04	Probabilistic Analysis of Yahtzee Justin Troyka, Micah Fogel
E-115	I12	Application of Operations Research Brandon Zhang, Mark Daskin

10:25 - 11:05 double time session

Acad. Pit A-138	M03	Gender Based Persecution as a Ground for Asylum: Establishing a Social Group Sylwia Matlosz, Ashima Sarup, Beatriz Sandoval
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10:25 - 11:30 triple time session

Lect. Hall B-206	K03	Film Production Inquiry Alex Ma, Alan Shen, Timothy Truong, Audrey Wells
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10:50 - 11:05

A-117	T01	Light Intensity with Respect to Altitude Christopher Gropp, Geza Gyuk
A-119	Q02	Analysis of Contained Muon Events in the MINOS Far Detector Matthew Castillon, Travis Mui, Maury Goodman
A-131	P06	Sequencing of the Citron Kinase Gene in Patients with Microcephaly Nina Gnedin, William Dobyns
A-133	P10	Epigenetic Mechanisms To Rescue Neural Tube Defects Caused By Mutated Pax3 Ernestina Perez, Robert Till, C. Shekhar Mayanil
A-135	H03	More Effective Teaching: Language in Context Janelle Peifer, John Stark
A-147	R01	An Examination of Treatment Impact on Cognitive Functioning in Children with Opsoclonus Myoclonus Syndrome (OMS) Kevin Crews, Scott Hunter
A-149	A01	Mechanism of Primordial Follicular Death and the Geography of Ovulation Brian Chang, Jessina Thomas, Teresa Woodruff

10:50 - 11:05 continued

Room	ID	
A-151	O19	Particulate Matter Causes Endothelial Cell Barrier Disruption and Induces Acute Lung Damage in a Murine Model of Asthma: Physiological and Genomic Contributions Eva Yuan, Joe Garcia, Liliana Moreno, Ting Wang
A-155	S05	The Arctic Circle: Future Existence and Ownership of Earth's Northern Ice Cap Eric Hultgren, Cody Morrow, Paavo Husen
B-110	P02	Alzheimer's: Comparison of Neuronal Proteins Perry Bradford, Susan Styer
B-116	O14	Affects of Antenatal Corticosteroids, Betamethasone, and Dexamethasone, on the Occurrence of Intraventricular Hemorrhaging (IVH) Sarah Rokosh, Maliha Shareef
B-133	C21	Elimination of the Negative Feedback Loop Between Mdm2 and p53 in Promoting p53 Mediated Apoptosis Jianning Shao, Donald Dosch
D-107	B02	Development of a Visual Feedback Interface for Stroke Rehabilitation Robotics Hendrik Dewald, Ana Maria Acosta, Ruben DeValois, Julius Dewald
D-110	P14	Neurobiology of Category Learning Milan Udawatta, Deborah Little
E-115	G02	The Economic Benefits of Early Childhood Intervention Jeffery Ding, Bo Shi, James Heckman, Rodrigo Pinto

11:15 - 11:30

A-113	K04	Renaissance Art and Its Meaning Lisa Peterson, Robert Kiely
A-117	T04	Multi-Wavelength Investigation of Active Galaxies Nathaniel Simpson, Geza Gyuk, David Steele
A-119	Q03	Future Possibilities for Experiments to Measure Theta13 Tiernan Evans, Maury Goodman
A-131	O10	The Phantom Inside Solomon Nittala, Gaurav Singh, A. Vania Apkarian
A-133	C01	Epicardial-Mesenchymal Transformation in the Developing Heart: An Analysis Megan Abel, Lindsey Choi, Robert Dettman
A-135	C08	Understanding the Origin of Murine Thymic Natural Killer Cells Anamaria Filipac, Markus Boos, Barbara Kee
A-147	C25	Health and Disease in Medieval Britain Ruijie Zhang, Anne Grauer
A-149	M01	The Future of Intellectual Property Sanat Bhole, Joanna Gunderson

11:15 - 11:30 continued

Room	ID	
A-151	O09	Evaluation of Ultrasensitive p24 Antigen Assay as an Alternative to Standard Viral Load and Antigen Assays in Diagnosis and Patient Treatment Monitoring Vineet Mohanty, Bill Kabat
A-155	C14	The Effects of Pseudo-Phosphorylation on Tropomyosin Conformation and Interaction with the Thin Filament Janel Jin, Brandon Biesiadecki
Acad. Pit A-138	S07	Looking From the Outside In: The Process of Organizational Transformation Jonathan Koch, Gouthami Rao, Glenn "Max" McGee
B-110	P12	Alzheimer's Disease Etiology: A Literature Review of Genetic, Environmental and Physiological Factors Jonathon Schwarzbauer, Susan Styer
B-116	O13	A Retrospective Analysis of Twenty Years Experience with Necrotizing Enterocolitis in a Neonatal Intensive Care Unit Hannah Reiser, Sarah Trevor, Jonathon Muraskas
B-133	A08	Dichloroacetate Used in a Novel Approach to Chemotherapy Arjun Nayini, Grant Rotskoff, Donald Dosch
D-103	C24	Examining Herpes Simplex Virus Type 1 (HSV-1) Entry by Live Cell Imaging Thiran Udawatta, Myung-Jin Oh, Deepak Shukla
D-107	Q04	Electron Beam Trajectory Optimization in a Fermilab Particle Accelerator Forrest Iandola, Sandeep Paruchuri, Raymond Filler III, Michael Syphers
D-110	C11	Sex and the Single Tree: An Investigation Using a Novel Genetic Tool to Understand the Reproduction of African Trees Elizabeth Ikejimba, Norbert Cordeiro

Please join us at 12:30 in the Academic Pit for our Student Recognition session,
hosted by Dr. Leon Lederman and Dr. Max McGee.

12:30 - 12:45

Room	ID	
A-117	A04	Polymorphisms in Cytidine Deaminase Ankit Jain, Yousif Kelaita, Donald LaVelle
A-135	Q01	A Measurement of Dijet Azimuthal Decorrelation at Forward Rapidities Stephanie Brandt, Don Lincoln
A-149	A03	A Far Red Tetrameric DsRed for Whole Cell Imaging Jingsi Fan, Benjamin Glick
B-110	E03	Chemical Sensing Based On Optical Interference of Modified Anodized Aluminum Oxide Surfaces Yifei Huang, Hsien-Hau Wang
B-116	C20	Dietary Intervention of Flax Seed/ Omega-3 Fatty Acids in Ovarian Cancer in the Laying Hen <i>Gallus domesticus</i> Shailee Shah, Donald Dosch, Dale Buchanan Hales
B-133	R12	Accessibility of Eponymous Verb Phrases Following Time Intervals Yuchen D Sun, David Rapp
Lect. Hall B-206	G01	Investigating Momentum Effects in Presidential Fundraising Using Prediction Markets Ryan Angelotti, Ryan Wang, Emily Oster

12:55 - 1:10

A-117	S01	Evaluating HIV Tests for Use in Tanzania Amy Allen, Timothy Feddersen
A-135	C19	Effects of Additional Beta on the Na-K Pump Ravi Pilla, Jack Kaplan
A-149	C07	An Investigation of the Evolutionary Context of Coniferous Leaves via Growth Behavior Jenny Fang, Seung Heo, Kevin Boyce
A-151	G05	Effect of Air Pollution on Standardized Test Scores in Santiago, Chile Ellen Song, Sergio Urzua
A-155	C23	Effective Negative Regulation by Suppressor of Cytokine Signaling 3 Produced by Treating Rat Retinal Müller Cells with Ciliary Neurotropic Factor Shobha Topgi, Vijay Sarthy
B-110	F04	MMORPGs: A Parallel Universe Cathy Li, Brian Sea
B-116	B05	Engineered NanoBio Conjugates for Targeted Brain Cancer Therapy Alisha Vimawala, Elena Rozhkova
B-133	R14	Do You Remember Information When You Make a Random Guess: An Implicit Memory Study Robert Washington, Ken Paller

12:55 - 1:10 continued

Room	ID	
D-103	M04	Crime Rates Over Twenty-Five Years: Aurora Versus Illinois Colin Phillips, Robert Kiely
D-107	R03	Handedness and Mathematical Ability at IMSA Hilary Dietz, Susan Styer
D-110	O03	The Effects of Caffeic Acid on Breast Cancer Cells Neelam Balasubramanian, Donald Dosch
E-115	R02	Liar, Liar Pants on Fire Crystal Croyl, Kenneth Higa, Sarah Lightfoot Vidal, David Evenson
Lect. Hall B-206	R08	Do Women Really Cry More? A Study on Gender and Empathy Ranait O'Connor, Joan Y. Chiao, Vani Mathur

1:20 - 1:35

Room	ID	
A-113	J03	D-503 and the Linguists: Language Control in Modern Dystopias Kyle Schirmann, Michael Hancock
A-117	D02	Impact of Privatization on the Performance of Chinese Business Firms During the Late 1990s Margaret Tu, David Dranove
A-119	E01	Environmentally Benign Oxidation of Important Chemical Intermediates Sena Dzakuma, Horacio Olivo
A-131	O15	Differences in Allele Distributions of the Glu298Asp and T-786C Single Nucleotide Polymorphisms in the eNOS Gene in Patients with Atherosclerotic Carotid Disease (CD) Versus a Healthy Control Population Vincent Rossi, Vera Shively
A-133	E05	The Strong Electrostatic Adsorption Method for the Synthesis of Pt-Fe/SiO₂ Alloy Catalyst Erin Talbot, Randall Meyer
A-135	A09	The Effects of Glutamate on Developing Mouse Morula to the Blastocyst Stage and Evaluation of Mouse Embryonic Stem Cells Post Glutamate Exposure Bani Saluja, Lon Van Winkle
A-147	N03	A Number Hiding Game Eric Shyu, Mark Fischler
A-149	P11	An Immunocytochemical Investigation of Inhibitory Interneurons in the Ventral Tegmental Area (VTA) and Substantia Nigra (SN) of the Rat Brain Sophia Pilipchuk, Louis Lucas
A-151	O11	Pigment Epithelium-Derived Factor Inhibits Angiogenesis by Activating C/EBPα to Induce Cell Cycle Arrest in Endothelial Cells. Karan Patel, Olga Volpert

1:20 - 1:35 continued

Room	ID	
A-155	C26	The Effects of Long QT3 Syndrome on Calcium Cycling in Cardiac Cells Jiabo Zheng, J. Andrew Wasserstrom
Acad. Pit A-138	S09	The Changing American Landscape: Latino Demographics of the 100 Largest US Cities Josue Pernillo, Gustavo Ulloa, Juan Andrade, Michael Rodriguez
B-110	E04	Methods for Carbon Nanotube Purification and Quality Analysis Andrew Nelson, Hsien-Hau Wang
B-116	C16	The Effects of Antibiotics Tetracycline and Chloramphenicol on Mitochondrial Protein Synthesis in Human White Blood Cells Ranjani Logaraj, Donald Dosch
B-133	R09	The Combined Effects of Altering Visual and Source Content of Aphorisms Seth Pree, David Rapp
D-103	I07	How We Learn From System Failures Jacob Maloney, Edward Swierz
D-107	R04	Physiological Responses and Coping Mechanisms to Stress Among High School Students Chelsea Fu, David Evenson
D-110	R06	Understanding Rhesus Monkeys' Abilities to Think Outside Their Instinctual Contexts Tatiana Lakshmanan, Lee Cera, Richard Duff, Jawed Fareed
E-115	K05	Beauty Counts: Mathematics in Art Patricia Whittaker, Clay Sewell
Lect.Hall B-206	R15	The Preference of Race During Mate Selection and Influences Behind Mate Selection in Asian Americans and Caucasian Americans Feiyang Ye, Bobby Cheon, Joan Y. Chiao

1:45 - 2:00

A-113	C10	Role of Lysyl Oxidase in Vasculogenic Mimicry in Melanoma Nathaniel Hausfater, Dawn Kirschmann
A-117	A05	Searching for Inhibitors for the Gene Encoding Acetyl Coenzyme A Carboxylase of Protozoan Parasites Philip Kuo, Robert Haselkorn
A-119	C02	Screen for ACD6-1 Suppressors Using T-DNA Insertion Pedro Aguirre, Jean Greenberg, Jiyoung Lee
A-131	P01	Gamma Band Frequency Analysis for Language Localization in the Brain Audrey Auyeung, Anjolie Gang, Anil Vaitla, Vernon Leo Towle
A-133	O07	Molecular Events in Inflammatory Bowel Disease: Cytokine-dependent Activation of Epithelial Myosin Light Chain Kinase Yue Lu, W. Vallen Graham, Jerrold Turner
A-135	I10	Liquid Argon Purity Demonstration Evan Rodrigues, Richard Schmitt

1:45 - 2:00 continued

Room	ID	
A-147	A07	The Energy of the Future: Ethanol DGS Akash Moradia, Saurav Datta, Seth Snyder
A-149	C22	Identification of Dicer-1 and Dicer-2 Binding Proteins Edward Song, Erik Sontheimer
A-151	C13	Determination of the Antiplatelet Effects of Anticoagulant Drugs Sonali Jayakar, Omer Iqbal
A-155	U02	A Spectrum of Religions: An Analysis of the Role of Religions in the Twentieth Century's Most Difficult Novel Shuang Zhang, Dennis Czerny
Acad. Pit A-138	L06	An Analysis of Gender Roles in Sixteenth and Seventeenth Century European Witch Trials Shawna Roberts, Robert Kiely
B-116	O04	Rapid HIV Testing in the University of Illinois at Chicago Emergency Room Jorge Jeria, Arika Verma, Richard Novak
B-133	R05	Visualizing and Analyzing Eye Movement from Paintings Sarah Kang, Steven Franconeri
D-103	I04	Designing, Building and Testing a Vertical Takeoff and Landing Aircraft Roy Fisher, Francisco Ruiz
D-107	P13	The Effects of Classical and Pop Music on the Memory of IMSA Students Katherine Tu, James Priovolos
D-110	S02	Teasing: What Separates the Victims from the Unaffected Erika Bongen, Christopher Kolar, Deborah McGrath
E-115	H02	Inquiry-Based Learning for Fifth and Sixth Graders Naomi Morphis, Michelle Kolar, Sarah Pfeifer
Lect. Hall B-206	R07	The Effects of Parental Psychopathology on Child Temperament Henry Liang, Laura Thompson, C. Emily Durbin

1:45 - 2:25 double time session

B-110	F03	Solving Text-Based CAPTCHAs Using Skeletal and Edge Analysis Justin Johnson, Ilya Nepomnyashchiy, Jason Rock, Brian Sea
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2:10 - 2:25

Room	ID	
A-113	J01	Writing Your Way to a Dystopian Novel Jennifer Byers, Michael Hancock
A-117	C12	IL-10 Inhibits Inflammation Mediated Cardiac Dysfunction Post-Myocardial Infarction Yaseen Jamal, Karthik Vantakala, Rajasingh Johnson, Raj Kishore, Prasanna Krishnamurthy, Erin Lambers
A-119	I08	Physics-Based Sound Generation Martina Pillay, Neelesh Patankar
A-131	T03	Deconvolution of the Photometric Redshift Distribution in Fourier Space Sapna Patel, Jennifer Roderick, Carlos Cunha
A-133	O06	Treatment of Breast Cancer Using an Oncolytic Adenovirus to Inhibit the Transforming Growth Factor-β Signaling Pathway Bob Lee, Janhavi Gupta, Prem Seth
A-135	C18	Identification of a Gene Responsible for Membrane Resistance in <i>Escherichia coli</i> Birce Onal, Eric Vimr
A-147	A06	Effect of Rosiglitazone on Transforming Growth Factor-β-Induced Fibroblast Activation and Migration During Wound Healing Yize Leng, Ashish Ghosh
A-151	D01	Analysis of Search Engine Marketing Elliot Margul, Sachin Agarwal
A-155	Q06	Symmetry In Physics Francis Walsh, Gabriel Kerr
Acad. Pit A-138	I02	Investigating Beneficial Robotics Mechanisms Caitlin Bunt, Ricardo Gonzalez, Ekaterina Kononov, Scott Page, James Gerry
B-116	C05	The Immunosuppressant Effects of Betaseron on Human Lymphocytes in Culture as a Possible Treatment for Multiple Sclerosis Catherine Crawford, Donald Dosch
B-133	R13	Perceptual Cues of Social Grouping Vaishali Umrikar, Joan Y. Chiao, Steven Franconeri
D-103	I01	Constructing Economically Feasible Magnetically Levitating Trains Cameron Breedlove, Jessica Durden, Jae Kim, Adam Leemans, Bohao Liu, Shaine Strullmyer, David Workman
D-107	L07	Distant Thunder: The Battle Fields of Colonial Illinois Sanat Bhole, Luis Carbajal, Nina Gnedin, Thomas Vandiver, Claiborne Skinner
D-110	L03	Comprehensive Overview of the Medical and Cultural Aspects of Green Tea Tianyu Du, Alyssa Winans, Dave DeVol
E-115	H01	IMSA on Wheels in Technicolor Theodore Atwood, Brian Flynn, Tracy Miller
Lect. Hall B-206	F02	Artificial Intelligence: Bridging the Gap Between Men and Machine Alexander Drummond, Kyle Hanson, Mike Ososky

A01**Mechanism of Primordial Follicular Death and the Geography of Ovulation****Presenter(s)**

Brian Chang, Illinois Mathematics and Science Academy
Jessina Thomas, Illinois Mathematics and Science Academy

Advisor(s)

Teresa Woodruff, Northwestern University

In the human, the ovary begins with two million follicles (units comprised of the egg and accompanying somatic cells) at birth. By puberty, only about 400,000 of these remain; the rest are lost in a tightly regulated manner named atresia. To study whether these follicles were dying because of apoptosis, follicular death was examined in pre-pubertal ovaries, where the loss of the most primitive type of follicle (primordial) could be seen. Common characteristics of apoptosis (such as DNA fragmentation, cleavage of PARP, pyknosis, and activation of caspase 3) were not found, indicating that primordial follicular death is not attributable to apoptosis. From these results, we hypothesized that the mechanism controlling follicular death was dependent on the follicle's location in the ovary, which could determine access to growth factors, hormones, and even oxygen from vascularization. The follicular geography of a monkey ovary was studied across the life span of the animal to determine if follicles were lost from certain regions preferentially or if they were chosen stochastically. Preliminary results indicate that ovulation is not dependent on the location of the follicle within the ovary and that another factor besides geography controls follicle recruitment and loss.

A02**Lanthanide Binding Protein****Presenter(s)**

Sena Dzakuma, Illinois Mathematics and Science Academy

Advisor(s)

Chuan He, University of Chicago
Cathy Poor, University of Chicago
Seraphine Wegner, University of Chicago

Transferrins are responsible for transporting metals such as iron throughout the human body. The metal binding pocket structure, created by amino acids, enables the HitA protein to bind to metals by presenting oxygen and nitrogen ligands. Grown in *E. coli* bacteria, the HitA protein is currently being investigated for its binding capabilities to lanthanide and actinide metals. Using titrations, we analyzed HitA's binding ability to iron to observe its proper functionality. The lanthanide metal Tb 3 (terbium) was added to a dilute solution of HitA. The solution was then concentrated and crystallization trials were set-up. We obtained Tb 3 bound HitA crystals that can be analyzed using X-ray crystallography. In the X-ray analysis, we are most interested in a rearrangement of the metal binding pocket structure. The study of iron binding proteins is fairly new and applications are far down the road. In the future, this study will be used for the removal of toxic metals in the body procured through contamination and highly reactive metals in the environment.

A03**A Far Red Tetrameric DsRed for Whole-Cell Imaging****Presenter(s)**

Jingsi Fan, Illinois Mathematics and Science Academy

Advisor(s)

Benjamin Glick, University of Chicago

Fluorescent proteins have revolutionized biomedical research as tools for *in vivo* imaging. DsRed, a red fluorescent protein, is a useful fluorescent reporter both alone and in two-color studies with green fluorescent protein (GFP). Tetrameric DsRed variants can be extremely useful in whole cell, tissue, and organism labeling due to their brightness and photo stability. However, redshifted variants of DsRed could potentially be suited to whole-organism labeling and live animal imaging studies due to the increased penetrance of longer wavelength light within living tissues. I am investigating making a novel red-shifted variant of a tetrameric DsRed with a surface that has been optimized for low cytotoxicity, in an attempt to create a useful tool for whole organism labeling and live tissue imaging. This involves mutating DsRed DNA using the polymerase chain reaction (PCR). The resulting DNA will be transformed into bacteria and the desired protein will be made by the bacteria. By looking at the bacterial colonies under certain filters and lights, we can pick out bacteria producing promising DsRed variants and characterize these variants for optimal labeling properties.

A04**Polymorphisms in Cytidine Deaminase****Presenter(s)**

Ankit Jain, Illinois Mathematics and Science Academy
Yousif Kelaita, Illinois Mathematics and Science Academy

Advisor(s)

Donald LaVelle, University of Illinois at Chicago

Sickle cell anemia is brought on by a mutation in the β -globin gene. Our laboratory is working on inducing γ -globin in the hopes of providing a treatment for these patients with sickle cell anemia. High concentrations of γ -globin inhibit sickling in red blood cells. A key drug in inducing this change in expression is decitabine, a drug that is inhibited by cytidine deaminase (CDA). By understanding how our body regulates CDA and the specific polymorphisms that affect its expression, the effectiveness of decitabine can be controlled and optimized for decitabine treatments in future clinical trials. The samples we worked with were from two baboons (*Papio anubis*) that respond differently to decitabine. By analyzing the sequences of the CDA gene, we can identify polymorphisms in the gene that could explain the different responses to decitabine. We first isolated polymorphic neutrophils for the purpose of extracting DNA. After isolating these white blood cells, we isolated the DNA. Using this DNA, we obtained PCR primers that isolate the CDA gene in humans, thereby allowing us to analyze the region and possibly sequence it. The results of this study could be used to identify polymorphisms to assist other research on decitabine in baboons.

A05**Searching for Inhibitors for the Gene Encoding Acetyl Coenzyme A Carboxylase of Protozoan Parasites****Presenter(s)**

Philip Kuo, Illinois Mathematics and Science Academy

Advisor(s)

Robert Haselkorn, University of Chicago

Acetyl coenzyme A carboxylase (ACC) plays a very important role in fatty acid metabolism. It catalyzes the first step in fatty acid biosynthesis in all living organisms. There is growing evidence that the downstream effects of ACC in *Trypanosoma*, *Leishmania*, and *Cryptosporidium* are essential for the survival of the parasites as well. We hope to screen for inhibitors of the ACC of these protozoan parasites, and to do so, we have cloned the gene encoding ACC of *T. brucei*, *L. braziliensis*, *L. major*, and *C. parvum* into yeast vectors. The next step is to test for complementation in yeast. With completely complementary DNA, we will be able to screen for inhibitors on a large scale and develop an upstream inhibitor of the diseases that these protozoan parasites cause.

A06**Effect of Rosiglitazone on Transforming Growth Factor- β -Induced Fibroblast Activation and Migration During Wound Healing****Presenter(s)**

Yize Leng, Illinois Mathematics and Science Academy

Advisor(s)

Ashish Ghosh, Northwestern University

Cell migration is crucial during wound healing. Transforming growth factor- β (TGF- β) plays a pivotal role in fibroblast activation, cell migration, and collagen synthesis. Deregulation in these processes leads to the development of diseases like fibrosis. TGF- β target genes CTGF and Cyr-61 (connective tissue growth factor family proteins) are known to play important roles during wound healing. TGF- β activates downstream target genes in fibroblasts via the activation of Smad and non-Smad pathways. The level of TGF- β -induced target gene activation is controlled by transcriptional repressors like peroxisome proliferator activated receptor- γ (PPAR- γ). PPAR- γ can be activated by the drug rosiglitazone. We investigated the effect of rosiglitazone on TGF- β -induced fibroblast activation and migration using established *in vitro* wound healing assay procedures. The effect of rosiglitazone on TGF- β -induced type I collagen synthesis as well as its effect on CTGF and Cyr-61 levels during wound healing were examined by Western blot. Results revealed that rosiglitazone inhibits TGF- β -induced fibroblast migration and type I collagen synthesis during wound healing. Additionally, rosiglitazone was found to inhibit TGF- β -induced expression levels of CTGF and Cyr-61. These results suggest that rosiglitazone, by acting through the suppression of CTGF and Cyr-61 expression, is an effective drug for controlling the levels of TGF- β -induced fibroblast activation and migration.

A07**The Energy of the Future: Ethanol DGS****Presenter(s)**

Akash Moradia, Illinois Mathematics and Science Academy

Advisor(s)

Saurav Datta, Argonne National Laboratory

Seth Snyder, Argonne National Laboratory

As we move further into the twenty-first century, fossil fuel reserves are depleting and oil prices are hitting record highs. Soon, there will not be any oil left. As this day approaches, new renewable alternative energy sources, like ethanol, are being developed. At Argonne National Laboratory, research is being conducted to make ethanol coproducts, like distillers grains and thin stillage (usually called DGS), more useful to cattle farmers and to make the ethanol distillation process cheaper. DGS is an alternative animal feed to whole corn. To make DGS more nutritious and cheaper to manufacture, bio-based solvents are being tested to try to extract as much protein and oil as possible. This would make the grains worth more. To do this experiment, bio-based solvents like ethyl lactate are in the process of being tested with DGS and then the test samples are being sent for protein analysis. Soon, the experimental data will be analyzed, potentially showing that bio-based solvents will be a feasible option for the ethanol process. This study will also possibly show that by providing cattle farmers with a viable alternative to corn as cattle feed, the price of ethanol can be lowered enough to effectively compete with gasoline.

A08**Dichloroacetate Used in a Novel Approach to Chemotherapy****Presenter(s)**

Arjun Nayini, Illinois Mathematics and Science Academy

Grant Rotskoff, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

A novel approach to treating breast cancer cells is reported. The potassium salt of the chemical dichloroacetate (DCA) was added to cultures of MCF-7, a human breast cancer cell line, to examine the effect. A dosage curve to determine the optimum efficacy of DCA revealed 7.5 $\mu\text{g/ml}$ as the most effective concentration for the initiation of apoptosis, or programmed cell death. A treated culture was tested for the presence of the active part of the caspase-3 protein, using a caspase-3/PPP32 colorimetric assay. Our results, when the MCF-7 cells were treated at 7.5 $\mu\text{g/ml}$, demonstrate that: 1) the presence of the active part of the caspase-3 protein in the treated cells underwent an apoptotic cell death; 2) the increased activity of pyruvate dehydrogenase complex (PDC) will lead to oxygen deprivation, causing the cells' apoptotic response. This newly established approach to general chemotherapy might allow for the treatment of cancer through the inducement of apoptosis.

A09**The Effects of Glutamate on Developing Mouse Morula to the Blastocyst Stage and Evaluation of Mouse Embryonic Stem Cells Post Glutamate Exposure****Presenter(s)**

Bani Saluja, Illinois Mathematics and Science Academy

Advisor(s)

Lon Van Winkle, Midwestern University

Glutamic acid (glutamate) is one of the twenty proteinogenic amino acids. Its transport mechanisms and signaling has been studied extensively in mouse embryos. Glutamate transporter and receptors have also been studied in the central nervous system. Our study targets how this amino acid affects the development from the morula to blastocyst stage. We remove two-cell embryos from the oviducts of day two impregnated mice using pH stable flushing media. Two cells were cultured to the morula stage in potassium simplex optimization medium (KSOM) depleted of glutamate and aspartate. The effect of incubated morula with and without 100 μ m glutamate was calculated by observing the number of morula that developed to the blastocyst stage over time. Comparison of radii of blastocoels was recorded over time at one hour intervals. At the time, the results have not been fully analyzed but will be ready for IMSAloquium. These experiments are an important preliminary step to what may happen when working with human stem cells. Glutamate is known to help keep mice stem cells undifferentiated. Keeping human stem cells undifferentiated longer could possibly lead to manipulation of the outcome of the differentiated stem cell.

A10**The Effect of Lighting as a Stress Factor on Lipid Production in Filamentous Spirogyra****Presenter(s)**

Nicholas Rock, Illinois Mathematics and Science Academy
Isaiah Tan, Illinois Mathematics and Science Academy

Advisor(s)

Susan Styer, Illinois Mathematics and Science Academy
Joseph Traina, Illinois Mathematics and Science Academy

Algae under stressful conditions can be prompted to produce lipids. The filamentous alga Spirogyra was tested to determine whether altering the photoperiod would effectively increase lipid production. Spirogyra cultured in a soil water medium was placed under grow lights at 24-, 16-, and 8-hour per day intervals. At the onset and after one week, the Spirogyra filaments were stained with Nile Red, a lipophilic fluorescence indicator, and observed under fluorescence microscopy. Photographs were taken of the Spirogyra both while stained under fluorescence, and while unstained under incandescent lighting. The images were compared to locate fluorescing lipids, and ImageJ software was used to measure these lipids as a percentage of cell area. Preliminary comparison of photographs suggest lipid content to be between one and two percent for algae with a 16-hour photoperiod. Future comparison should yield an optimal set of lighting conditions that will be reported during which lipid production in Spirogyra peaks. Such results may contribute to the growing interest in algal lipid as a biofuel source in light of diminishing fossil fuel resources.

B01**Correlation Between Cholesterol and Hyper-Contraction of Smooth Muscle During Asthma****Presenter(s)**

Frederick Damen, Illinois Mathematics and Science Academy

Advisor(s)

Irena Levitan, University of Illinois in Chicago

We seek to study the possible link between HDL and LDL cholesterol and asthma. Since asthma may involve the influx of Ca^{2+} , which is sensitive to electric membrane potential, and LDL may block KIR channels and affect the membrane potential, there exists a mechanism to connect the two. To ultimately make electrical measurements on individual smooth muscle cells, patch clamp recording had to be learned and mastered first on practice cells. Patch clamp recording is a technique of creating a seal between the cell membrane and a glass pipette that allows recording of the currents that flow through the membrane. As this technique is quite difficult and tedious to perform, the time in this project up until now has been in attempt to perfect this method for collecting results. We can know if a successful patch has been achieved if the resulting reading shows no signs of leakiness and has a good curve to it. Now that we are coming close to consistently good results, we can begin to perform patch clamp recordings on our line of smooth muscle cells to determine whether cholesterol-induced changes affect KIR activity. Understanding the roles of cholesterol and KIR channels in hyper-contractility of asthma can lead to developing new therapeutic strategies to treat asthma.

B02**Development of a Visual Feedback Interface for Stroke Rehabilitation Robotics****Presenter(s)**

Hendrik Dewald, Illinois Mathematics and Science Academy

Advisor(s)

Ana Maria Acosta, Northwestern University Feinberg School of Medicine

Ruben DeValois, Northwestern University Feinberg School of Medicine

Julius Dewald, Northwestern University

Northwestern University's School of Medicine is in possession of a rehabilitation research robot called the ACT 3D. This robot can generate virtual mechanical environments that allow for the elimination and reintroduction of the weight of the paralyzed arm in stroke survivors to progressively increase the arm's workspace. The goal of this project is to combine this mechanical environment with a visual one, like a modern video game, in an effort to provide a more motivating training environment for stroke rehabilitation. We decided to use a virtual reality P5 glove as the means to integrate the movements on the robot with computer games. We experimented continuously with possible applications of the glove, such as keyboard and mouse emulation, and actual P5 supported games. We currently have the glove functioning properly with a game in two dimensions. Our next step will be to try the use of P5 mediated video games with actual stroke survivors and survey their interest in the gaming environment as opposed to the basic visual displays currently being used. We predict that if an appropriate game is chosen, the stroke subject's efforts to increase the workspace of the paretic arm will improve significantly.

B03

The Practicality of Dry Laboratory Methodology and Geometric Modeling with a Mouse Brain in the Development of Drug Treatments for Neurodegenerative Diseases

Presenter(s)

Joseph Ou, Illinois Mathematics and Science Academy
Sonny Song, Illinois Mathematics and Science Academy

Advisor(s)

Andreas Linninger, University of Illinois at Chicago
Anargyros Politis, University of Illinois at Chicago

The brain is composed of various substructures, each performing its unique function that is essential for the success of the system as a whole. The structural complexity of the brain causes difficulty in treating numerous neurodegenerative diseases and necessitates the use of three-dimensional models of the substructures to capture the role that each one plays in terms of space and time through geometric modeling. To achieve this end, image reconstruction is a methodology that can be implemented using specific programs to reproduce certain substructures of the brain from medical images like magnetic resonance imaging or computed tomography. The effectiveness of this new, dry laboratory approach for scientific study is still being debated. We reconstructed the cortex, ventricular system, caudate putamen, and thalamus of a mouse brain from MRI images with the help of MIMICS reconstruction software. We then introduced these structures into grid generators where we obtained the computation mesh for further computational fluid dynamics analysis with the program FLUENT. It was discovered that these programs were invaluable in constructing accurate models to use in the development of drug therapies for neurodegenerative diseases, but much time and background knowledge is needed for accuracy and success.

B04**Quantifying the Effect of Glucose on the Structure of Type IV Collagen Tissue Fibers of Diabetic Patients****Presenter(s)**

Jasmine Shah, Illinois Mathematics and Science Academy

Advisor(s)

Eric Brey, Illinois Institute of Technology

Diabetes is an internationally researched disease known to affect glucose levels in the patient's body and consequently alter mechanical properties of the body's tissue. It is assumed that crosslinking with glucose-6-phosphate alters the physical and viscoelastic properties of skin collagen tissue found in the dermis. The goal of this study is to systematically quantify the influence of glucose-6-phosphate on the fiber structure and density and fluorescent cross-link content of collagen tissue so as to accurately reproduce and understand the effect diabetes has on a patient's dermis collagen tissue. This goal was achieved through an imaging process using confocal reflectance microscopy and *in vitro* self-assembled collagen hydrogels used to simulate the *in vivo* diabetic milieu. Through observing the tissues of diabetic and non-diabetic patients alike, it was found that, using data from both *in vivo* and *in vitro* situations, the introduction of glucose-6-phosphate and regulation of any other factors resulted in a statistically significant increase in fiber diameter and density of the collagen fibers as a result of cross-linking between fibers at the molecular level. In diabetic patients, the glycation of collagen results in visible changes to the body similar to the effects of aging. Our simulation evaluates that these changes are being caused by the many alterations in the structure of cross-linking collagen fibers at the molecular level.

B05**Engineered NanoBio Conjugates for Targeted Brain Cancer Therapy****Presenter(s)**

Alisha Vimawala, Illinois Mathematics and Science Academy

Advisor(s)

Elena Rozhkova, Argonne National Laboratory

Treatment of cancer still remains one of the biggest challenges today, despite recent improvements in surgery and therapy. Brain cancer constitutes a challenging and unsolved clinical problem, and accounts for 13,000 deaths in the United States yearly. Current treatments have been particularly ineffective, due to the nonspecificity of drugs. However, nanoparticle technology has surfaced as a potential vector for drug delivery that can be engineered with multifunctionality to provide molecular specific detection and treatment. Photodynamic therapy using TiO₂ semiconductor metal nanoparticles that are able to induce reactive oxygen species (ROS) in response to light exposure is a particularly attractive form of cancer therapy. In this investigation, various surface modified TiO₂ nanoparticles were characterized using the X-ray fluorescence nanoprobe and Atomic Force Microscopy (AFM), and then conjugated with the anti-human-iLRa2 (mAb) antibody. Complete binding of the mAb was verified by comparative SDS-PAGE electrophoresis of the final TiO₂-Ab conjugate. Photocatalytic activity of the semiconductor material in the nanobioconjugate was then verified using silver nitrate assay. UV-Vis spectroscopy, ELISA, nanodrop spectrophotometry, and comparative zeta potential measurements were also used to determine the efficacy of the conjugate.

C01

Epicardial-Mesenchymal Transformation in the Developing Heart: An Analysis

Presenter(s)

Megan Abel, Illinois Mathematics and Science Academy
Lindsey Choi, Illinois Mathematics and Science Academy

Advisor(s)

Robert Dettman, Northwestern University Feinberg School of Medicine

During vertebrate embryonic development, cells from the epicardium (outermost layer of the heart) invade the myocardium (muscle layer of the heart), to form the coronary arteries. Cultured embryonic day 5.5 (E5.5) epicardial cells (ECs) and chick hearts respond to transforming growth factor beta-1 (TGF β -1), a molecule thought to trigger invasion. However, by E10.5, the ECs lose their ability to invade and respond to TGF β -1. To test when ECs lose their ability to respond to TGF β -1, hearts ranging from E5.5 to E10.5 were treated with TGF β -1. ECs on the heart surface were marked by AdlacZ adenovirus infection. After 48 hours in the medium, the hearts were sectioned, stained, and lacZ⁺ cells scored. Two variable t-tests and standard deviation tests were performed. We observed a significant increase in invasion from E5.5 untreated (11.45%) to E5.5 TGF β -1 (30.66%). However, E7.5 untreated (15.58%) to E7.5 TGF β -1 (17.28%) was not significantly different, showing that TGF β -1 is no longer effective at increasing epicardial invasion. We are currently testing if TGF β -1 receptors are expressed in ECs from E5.5, E7.5 and E10.5 and we will present our results at IMSAloquium.

C02

Screen for ACD6-1 Suppressors Using T-DNA Insertion

Presenter(s)

Pedro Aguirre, Illinois Mathematics and Science Academy

Advisor(s)

Jean Greenberg, University of Chicago
Jiyoung Lee, University of Chicago

Accelerated cell death (ACD6) in *Arabidopsis thaliana* plants is involved in the pathogen defenses and programmed cell death by interacting with other proteins. ACD6-1 mutants confer enhanced pathogen resistance to *Pseudomonase syringae*, improved defense response, and reduced whole plant stature. The signal molecule salicylic acid (SA) is important for pathogen defense. ACD6 regulates SA-mediated defense signaling. Furthermore, ACD6-1 plants hyper accumulate SA, an event highly correlated with their reduced size. Our research worked to identify new defense-related genes in the ACD6-1-involved defense pathway by inserting foreign DNA into these genes in order to disrupt them. If we did happen to disrupt a gene involved in this pathway, the mutated plant might be partially or fully recovered in size. Such a gene would be a candidate for involvement with the ACD6 mediated signaling pathway. Our research discovered a candidate gene that we labeled suppressor of ACD6 59 (sac-59). This gene was shown to grant a partial recovery in stature, suggesting that it is involved in the ACD6-1 signaling pathway. Further validation must take place in order to confirm the role of the gene in the pathway.

C03

Real-Time Imaging of the Cellular Redistribution of HSP27-CFP and HSP70-GFP Fusion Proteins in Cardiovascular Smooth Muscle Cells to Assess Actin Cytoskeletal Remodulation

Presenter(s)

Luis Carbajal, Illinois Mathematics and Science Academy

Advisor(s)

Jody Martin, Loyola University

The heat shock protein, HSP27-CFP, has been suggested to regulate actin cytoskeleton structure and to modulate the interaction of actin and myosin due to its biochemical properties and high expression levels in smooth muscle cells (SMCs) under stress. This may contribute to the mechanical plasticity of SMCs. It is also proposed that HSP27-CFP's interaction with the actin cytoskeleton is regulated by its phosphorylation via the p38 MAP kinase pathway (MAPK), which is inhibited by SB 203580. This pathway is activated by mechanical and oxidative stress, like hydrogen peroxide. The best characterized cytoprotective protein, able to protect cells and organisms against a variety of noxious stresses, is HSP70-GFP. We have established a real-time oxidative stress smooth muscle cell imaging protocol utilizing time lapse microscopy to examine cellular redistribution of HSP27-CFP, a fusion protein, in response to pathophysiological amounts of hydrogen peroxide (200 μ M \pm SB 203580). Analysis of phalloidin tagging of actin, to examine cytoskeletal integrity after cell fixation, is underway. Immunostaining of endogenous HSP70-GFP and HSP27-CFP will characterize and verify the time lapse observations. Taken together, the results will illustrate the role of HSP27-CFP in the oxidative stress response of smooth muscle cells.

C04

Detecting the Difference Between Normal and Cancerous Stem Cells Through Analysis of Morphology, Gene Expression, and Effects of Dichloroacetate (DCA)

Presenter(s)

Hyun Cho, Illinois Mathematics and Science Academy
Jimmy Liu, Illinois Mathematics and Science Academy

Advisor(s)

Morris Kletzel, Childrens Memorial Hospital
Marie Olszewski, Childrens Memorial Hospital

Developments in oncology research point to stem cells as a promising new means through which to cure cancer. We observed the morphology, gene expression, and response to dichloroacetate (DCA) of normal and cancerous stem cells. Mononuclear cells isolated from human blood were cultured for experimentation. We tested several different DCA concentrations to determine if cancer cells and normal cells die in DCA. To determine which stem cell markers exist on the cells, we performed flow cytometry, a technique used to analyze physical and chemical characteristics of single cells flowing through an electronic detection apparatus. We also used RT-PCR to determine the genes expressed. When DCA was applied to the experimental group, the concentration of cells was successfully suppressed, implying that DCA has the effect of prohibiting cell proliferation. This implies the restoration of apoptosis in cancerous cells and the preservation of normal cells. DCA could be pursued as a cancer therapy because of its preferential effect on cancerous cells, and consequently, we plan to further test its potential. In particular, we plan to test DCA on cell cultures with both normal and cancerous cells combined; current tests have only tested DCA on normal and cancerous cells individually.

C05**The Immunosuppressant Effects of Betaseron on Human Lymphocytes in Culture as a Possible Treatment for Multiple Sclerosis****Presenter(s)**

Catherine Crawford, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

One of the most important features of the body's immune system is its ability to distinguish between self and non-self. This enables it to generate reactions against invading organisms, which may be harmful. Both T-lymphocytes and B-lymphocytes, critical components of the immune system, act in accordance with the body's self and non-self components; however in autoimmune diseases, the ability to distinguish between these two components is inefficient, and the body attacks itself. Although there is some debate, it is widely accepted that multiple sclerosis is an autoimmune disease. An inflammatory, chronic disorder where T-Lymphocytes target the myelin sheath of neurons, Multiple Sclerosis results in the injury of neurons, causing nerve messages to be sent less efficiently to the body. Betaseron (interferon I β) is a commonly used immunosuppressant in treating Multiple Sclerosis. My research has focused on the effect of this drug on the immune system, specifically T-lymphocytes and monocytes. In this investigation, a caspase Assay was run on betaseron treated CEM and U937 cell lines in order to determine whether betaseron initiated apoptosis, or programmed cell death, in T-cells and monocytes. Understanding the effects of betaseron on the immune system will help to better understand the causes of multiple sclerosis and to formulate the most effective dosages for administering betaseron.

C06**Zebrafish Embryogenesis: The Effects of Temperature on OTX2 and RALDH2****Presenter(s)**

Bryan Denig, Illinois Mathematics and Science Academy
Anastasia Rahlin, Illinois Mathematics and Science Academy

Advisor(s)

F. Bryan Pickett, Loyola University

Our experiment examines the temperature dependent expression of two developmental genes expressed in early embryogenesis of zebrafish, Raldh2 and Otx2, through the generation of RNA probes specific to these genes. Raldh2 produces retinol, a protein, which impacts the pattern formation of hindbrain and spine; Otx2 codes for a transcription factor responsible for organizing the forebrain in vertebrates. To make RNA probes, Otx2 and Raldh2 plasmids containing the viral T3 and T7 promoters were grown in *E. coli*. Transcription reactions were performed to generate the sense and antisense strands as probes for the transcripts of these two genes. Zebrafish embryos were collected and separated into 33°C and 28°C water baths in order to conduct developmental staging at these two temperatures. Collected embryos will be probed with synthetic RNAs. This research provides a valuable foundation for further studies of embryogenesis, specifically relating to environmental stressors and their impact on early gene expression.

C07**An Investigation of the Evolutionary Context of Coniferous Leaves via Growth Behavior****Presenter(s)**

Jenny Fang, Illinois Mathematics and Science Academy
Seung Heo, Illinois Mathematics and Science Academy

Advisor(s)

Kevin Boyce, University of Chicago

The study of cellular development of leaves has long been a popular subject among botanists. However, the focus of the study has always been among the angiosperms. Our experiment turned away from the traditional trend and investigated the gymnosperms. Throughout the year, we recorded the cell sizes along the length of maturing coniferous leaves in order to determine where cell growth was initiated. Our experiment consists of only the coniferous genus *Taxus*. From our data, we concluded that the cell growth in the coniferous family *Taxaceae* initiated in the base of the leaf. Our discovery was significant for the result was not expected. Other conifers closely related to *Taxaceae* such as *Agathis* and *Nageia* are known to grow from the tip and various ancestral fossil conifers are thought to do the same. It was assumed that the ancestor of conifers grew from the tip as is common in other plants. Our findings can change this conventional view. The next step would be to analyze the cell growth in other genus of coniferous leaves. A comparison of growth in various species would demonstrate distinctions and similarities within conifer plants, thus painting a more comprehensive evolutionary history of coniferous leaves.

C08**Understanding the Origin of Murine Thymic Natural Killer Cells****Presenter(s)**

Anamaria Filipac, Illinois Mathematics and Science Academy

Advisor(s)

Markus Boos, University of Chicago
Barbara Kee, University of Chicago

Natural killer (NK) cells are a form of lymphocyte whose role is to produce inflammatory cytokines or induce cell lysis of malignant, infected, or stressed cells. NK cells are known to develop in the bone marrow (BM), but a small population of NK cells has also been proposed to develop in the thymus. However, it is also possible that these cells represent a mixed population that includes developing T cells. To address this, we performed a phenotypic characterization and *in vitro* clonal analyses on developing BM and thymic NK cells placed in culture conditions that promoted the development of either NK or T cells. We discovered that NK progenitors (NKPs) from the thymus generated a smaller percentage of NK cells than BM NKPs under both culture conditions. Importantly, thymic NKPs preferentially became T cells in T lineage culture conditions while BM NKPs primarily retained characteristics of NK cells, suggesting that thymic NK progenitors primarily represent T lineage cells. However, mature NK cells from both the BM and the thymus remained committed to the NK lineage. These findings show that NK cell development in the thymus cannot be characterized in the same way as conventional NK cell development in the BM.

C09

The Effect of Food Dyes and Acid/Base Indicators on Bacteria

Presenter(s)

Paoula Gueorguieva, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Susan Styer, Illinois Mathematics and Science Academy

More than 70% of all foods contain food colorings. Many of these coloring substances have been noticed to have some unusual effects on bacteria and especially on bacteria that are essential for digestion. *Lactobacillus fermentum* is a gram positive bacteria naturally found in the human digestive system. It helps with the production of some enzymes in the human body and it is extremely important for digestion. The effect of food dyes on bacteria, in particular *L. fermentum* and other bacteria in the human stomach affects the person's digestive system. I ran a Kirby Bauer analysis on each of the seven types of bacteria including the anaerobe *L. fermentum*. Six of the seven types of bacteria I used were related to the human and one of them was a soil bacterium. After approximately 48 hours, I observed the results of the test for the different bacteria. The different indicators and food dyes had different effects on the seven types of bacteria, some inhibiting and some enhancing bacteria growth.

C10

Role of Lysyl Oxidase in Vasculogenic Mimicry in Melanoma

Presenter(s)

Nathaniel Hausfater, Illinois Mathematics and Science Academy

Advisor(s)

Dawn Kirschmann, Childrens Memorial Research Center

Angiogenesis is a process that allows endothelial cells (blood vessels) to penetrate a tumor, which facilitates tumor growth and eventual metastasis. Aggressive melanoma tumor cells are involved in an alternative form of angiogenesis termed vasculogenic mimicry, in which tumor cells genetically change in order to mimic endothelial cell-like vessels. One protein, which is expressed by aggressive melanoma tumor cells, is lysyl oxidase (LOX) which is an enzyme that facilitates the cross-linking of collagens involved in many biological processes, including blood vessel formation and strength. Our hypothesis is that LOX is responsible for facilitating the formation of vasculogenic networks (tubes), and that inhibiting LOX will stop the formation of these tubes. We have observed that there is a high concentration of LOX in the vasculogenic tubes of aggressive tumor cells. Also, when LOX is re-expressed in nonaggressive tumor cells, proteins associated with tube formation also increase. Thus, we can conclude that LOX is involved in the formation of vasculogenic tubes, however the exact mechanism is not currently known. This has wide reaching implications in cancer treatment and the development of anti-LOX agents for the treatment of tumors that are resistant to standard anti-angiogenic therapies. (Supported by NIH/NCI CA59702.)

C11

Sex and the Single Tree: An Investigation Using a Novel Genetic Tool to Understand the Reproduction of African Trees

Presenter(s)

Elizabeth Ikejimba, Illinois Mathematics and Science Academy

Advisor(s)

Norbert Cordeiro, The Field Museum

Many ecologists consider the forest region of the East Usambara Mountain Range in Tanzania as East Africa's Garden of Eden. The ecosystems within the area contain diverse organisms found nowhere else in the world. This project examined the genetic effects of habitat disturbance on *Sorindeia* and *Leptonychia* trees due to logging and other forms of large scale cultivation. Microsatellite markers were used to create genetic fingerprints of adult trees and their offspring in fragmented and continuous forests. The microsatellite markers were then tested for Hardy-Weinberg equilibrium and potential linkage to verify a suitable set of markers for further study. Two out of the nine markers were rejected in the *Sorindeia* tree due to high levels of homozygosity. The remaining microsatellite markers are now being used to examine if habitat disturbance affects the tree species' reproduction. The results of this research will be used to promote conservation of the endemic trees and essentially the forestry of the region.

C12

IL-10 Inhibits Inflammation Mediated Cardiac Dysfunction Post- Myocardial Infarction

Presenter(s)

Yaseen Jamal, Illinois Mathematics and Science Academy

Karthik Vantakala, Illinois Mathematics and Science Academy

Advisor(s)

Rajasingsh Johnson, Northwestern University Feinberg School of Medicine

Raj Kishore, Northwestern University Feinberg School of Medicine

Prasanna Krishnamurthy, Northwestern University Feinberg School of Medicine

Erin Lambers, Northwestern University Feinberg School of Medicine

During left ventricular modeling following myocardial infarction (MI), pro- and anti-inflammatory cytokines are key factors to improving heart function. Prototypes of two classes of cytokines are tumor necrosis factor alpha (TNF- α) and interleukin 10 (IL-10). This study tested the hypothesis that inflammation mediated cardiac dysfunction in mice is inhibited by IL-10 treatment. MI was induced in mice and mice were either treated or not with IL-10 injections. Heart functions and inflammatory responses were assessed following MI. Results from echocardiography showed an improved heart function in mice receiving IL-10. This was assessed through an evaluation of the diastolic and systolic diameters of the left ventricle. Furthermore, immunofluorescence staining of cardiac tissue for inflammatory cells showed an increase of inflammatory cells in untreated mice while the accumulation of inflammatory cells was diminished in mice treated with IL-10. IL-10 treatment also suppressed the mRNA expression of a number of pro-inflammatory cytokines. Mechanistically, IL-10 mediated inhibition of inflammatory cytokines was mediated by a substantial reduction in the mRNA half-lives of selected genes, including that of TNF- α . Together these data indicate that inhibition of inflammation in the injured hearts by IL-10 enhances heart function and recovery post-MI.

C13

Determination of the Antiplatelet Effects of Anticoagulant Drugs

Presenter(s)

Sonali Jayakar, Illinois Mathematics and Science Academy

Advisor(s)

Omer Iqbal, Loyola University Medical Center

Platelets play an important role in the formation of a primary haemostatic plug and eventual clot. There are numerous glycoprotein IIb/IIIa receptors present on the surface of each platelet that facilitate aggregation. The purpose of this study was to determine whether anticoagulant drugs have any additional antiplatelet properties. Blood was drawn from healthy volunteers and the citrated blood was centrifuged to obtain platelet-rich plasma. This was used in the AssayMax Human GPIIb/IIIa ELISA assay, which uses a quantitative sandwich enzyme immunoassay technique that detects and measures GPIIb/IIIa receptor density. Among the several anticoagulant drugs studied, argatroban and its generic forms, slovastan, gartban, and argaran, showed antiplatelet effects. A synergistic response was seen when two antiplatelet drugs, such as aspirin and dipyridamole, or triflusal and dipyridamole, were used. Antiplatelet drugs are important in the management of patients who have recently suffered from heart attacks or strokes. A combination of anticoagulant and antiplatelet drugs are administered in such cases. However, proper dosage adjustment must be made in order to avoid bleeding complications.

C14

The Effects of Pseudo-Phosphorylation on Tropomyosin Conformation and Interaction with the Thin Filament

Presenter(s)

Janel Jin, Illinois Mathematics and Science Academy

Advisor(s)

Brandon Biesiadecki, University of Illinois at Chicago

Tropomyosin, a regulatory protein in the thin filament, plays a crucial role in the regulation of striated muscle contraction. There is a single phosphorylation site on tropomyosin at Ser-283 on the head-to-tail overlap region, suggesting that phosphorylation can considerably alter the conformation and binding of tropomyosin within the thin filament. Recent studies show transgenic mouse muscle exhibiting decreased tropomyosin phosphorylation (Tm-P) exhibit decreased cardiac muscle force. Levels of Tm-P are also higher in neonatal cardiac muscle than adult cardiac muscle. These findings further suggest a significant role of Tm-P in developmental or regulatory functions of muscle contraction. This investigation involved *in vitro* measurements of tropomyosin interactions using recombinant tropomyosin to study the conformation and interactions of wild type (Ser-283), phosphorylation-null (S283A), and pseudo-phosphorylated (S283D) tropomyosin. ELISA epitope analysis indicates that tropomyosin pseudo-phosphorylation affects the binding of the CH1 antibody to an epitope in the tropomyosin molecule. ELISA solid phase protein binding assays indicate altered binding of the recombinant tropomyosin to troponin T. These results show significant differences in the conformation of recombinant tropomyosin proteins and altered interaction between tropomyosin and the thin filament, suggesting that tropomyosin phosphorylation may play a key role in modulation of cardiac muscle contraction.

C15**The Role of Protein Kinase C in the Degradation of the G-Protein Coupled Receptor CXCR4****Presenter(s)**

Kristen Lee, Illinois Mathematics and Science Academy

Advisor(s)

Adriano Marchese, Loyola University

Stimulation of the G protein coupled receptor CXCR4 activates several intracellular pathways and has also been linked to breast cancer metastasis and HIV infection. Faulty endocytic sorting of CXCR4 has been connected to increased receptor levels, which contribute to a greater metastatic potential of breast cancer. However, the mechanisms mediating CXCR4 endocytic sorting are poorly understood. The purpose of this investigation was to explore the mechanism by which the mitogen phorbol myristate acetate (PMA) promotes CXCR4 degradation; specifically I attempted to determine if protein kinase C (PKC) mediated PMA degradation of CXCR4. By conducting a degradation assay in which the cells were exposed to the PKC inhibitors BISI and BISV and subsequently treated with either PMA or the CXCR4 ligand, stromal cell derived factor 1 α (SDF), I examined the effects of PKC inhibition on CXCR4 degradation. I then quantified the amount of CXCR4 degraded using Western blot and densitometry analysis. The primary results of this data may indicate that PKC is implicated in PMA promoted CXCR4 degradation. Hopefully in the coming days the investigation will elucidate a mechanism implemented in CXCR4 degradation and serve as a stepping stone to research on breast cancer metastasis.

C16**The Effects of Antibiotics Tetracycline and Chloramphenicol on Mitochondrial Protein Synthesis in Human White Blood Cells****Presenter(s)**

Ranjani Logaraj, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Antibiotics such as tetracyclines and chloramphenicol work by inhibiting bacterial protein synthesis. However, the mitochondria in human and other eukaryotic cells possess prokaryotic ribosomes like those of bacteria. Mitochondrial ribosomes synthesize vital subunits of proteins such as cytochrome c oxidase, an important enzyme in converting glucose to ATP. This study examined the effects of tetracycline and chloramphenicol on the synthesis of cox-1, a mitochondrial-encoded subunit of cytochrome c oxidase. Human white blood cells were grown in culture with varying degrees of each antibiotic. Western blots were performed to measure the amount of cox-1 in each sample and to measure the levels of actin, a nuclear encoded protein, for comparison. It was found, as was expected, that the level of actin is not affected by the addition of tetracycline or chloramphenicol, but the results for cox-1 have been inconclusive and analysis is ongoing. Currently, inhibition of mitochondrial protein synthesis is recognized as significant to antibiotic toxicity in hosts. However, many new antibiotics work through inhibiting prokaryotic ribosomes. Studies that focus on how different concentrations of such antibiotics affect mitochondrial protein synthesis can help determine the dosages that will minimize toxicity to the host.

C17**Partial Differentiation of Adult Stem Cells into Neurons Upon Addition of β -Mercaptoethanol and Retinoic Acid****Presenter(s)**

Birce Onal, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Adult stem cells derived from bone marrow have previously been differentiated into neuron cells *in vitro* and have functioned as neuron cells *in vivo*. Upon addition of β -mercaptoethanol and retinoic acid to a culture containing adult mouse bone marrow stroma stem cells, changes to the phenotype and genotype of the cells were observed. Exposure to β -mercaptoethanol and retinoic acid for 48 hours resulted in a cell structure resembling that of neuronal cells when seen under a microscope. A Western blot targeting the expression of neuron-specific β -tubulin class III protein with a mouse monoclonal antibody TU-20 confirmed a slight upregulation of the protein in response to the neuronal cocktail. The antibody binding experiment to localize the protein within treated cells is currently in progress. These results will elucidate the molecular mechanisms of stem cell differentiation in response to specific chemical treatments.

C18**Identification of a Gene Responsible for Membrane Resistance in *Escherichia coli*****Presenter(s)**

Birce Onal, Illinois Mathematics and Science Academy

Advisor(s)

Eric Vimr, University of Illinois at Urbana Champaign

The *Escherichia coli* K1 strain utilizes many mechanisms in order to infect hosts and evade immune system response molecules such as cationic antimicrobial peptides (CAMPs). When a mutant *E. coli* K1 strain was created through the addition of a transposon element at a random point in the bacterial genome, the bacteria were unable to grow in the presence of the antimicrobial peptide protamine. Investigation of the genome yielded two genes, c4397 and c4398, that the transposon element potentially disrupted. This investigation confirmed that the c4397 gene is responsible for resistance to protamine by successfully turning off one gene at a time and observing the growth of the knockout strains in medium containing protamine. The characterization of the gene product began by using in frame enzymatic fusions in the pJBS633 plasmid, and it was determined that the product of this gene is not located in the periplasm or on the cytoplasmic membrane. Further study on this gene will elucidate the use of one of many protective functions of *E. coli* membranes and the bacteria's interaction with and evasion of cationic antimicrobial peptides.

C19**Effects of Additional Beta on the Na-K Pump****Presenter(s)**

Ravi Pilla, Illinois Mathematics and Science Academy

Advisor(s)

Jack Kaplan, University of Illinois at Chicago

The addition of surplus beta subunits gives direct insight into the structure, function, and regulatory mechanisms of the sodium potassium (Na-K) pump. Previous research on altered Madin-Darby canine kidney (MDCK) cells has shown stability in cellular cohesion even after an increase in alpha-beta subunit levels. To determine the potential effects of the additional beta subunits, we used transfected human embryonic kidney (HEK293) cells. Several tests were performed including a Lowry protein assay, Western blots in order to recognize concentration changes in specific alpha and beta levels (using specific antibodies - flag beta antibody which recognizes just beta), and cell fractionations to observe alpha-beta expression in the plasma membrane, the endoplasmic reticulum, and the golgi complex. We will follow these tests with a transepithelial resistance measurement to check for an increase in cellular cohesion. These studies will help us to possibly gain a new level of control on the cohesion between cells.

C20**Dietary Intervention of Flax Seed/ Omega-3 Fatty Acids in Ovarian Cancer in the Laying Hen *Gallus domesticus*****Presenter(s)**

Shailee Shah, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Dale Buchanan Hales, University of Illinois at Chicago

The laying hen is the only animal model that spontaneously develops surface epithelial cancer similar to human ovarian cancer. Dietary intervention has shown to slow the mechanisms of breast and colon cancer, suggesting that a therapeutic treatment exists. Omega-3 fatty acid diets have been preventative of breast cancer and may be critical for suppression of ovarian cancer. Several proteins, including COX-1 and 2, E-cadherin, N-cadherin, and vimentin, play a critical role in the development of various cancers. The purpose of the study was to determine the effect of omega-3 fatty acids on these various proteins in the development of ovarian cancer. To study this, we implemented a 10% flax seed enriched diet on two-hundred 2.5 year old hens for one year to determine the effects of omega-3 fatty acids on the cancer development. Tissue samples and RNA were taken from the hens, and RT-PCR as well as immunohistochemical stains performed. The flax seed hens showed a significant decrease in COX-1 and COX-2 mRNA in total ovarian surface epithelium compared to control hens. The immunohistochemical stains showed a reduction of COX enzyme in flax-fed hens. Although there was a significant decrease in COX enzymes and although COX enzymes are critical for the production of prostaglandins in egg shell formation, there was no effect on the hen's egg laying. These observations may provide information critical to a therapeutic treatment of flax seed as a chemosuppressant for ovarian cancer.

C21

Elimination of the Negative Feedback Loop Between Mdm2 and p53 in Promoting p53 Mediated Apoptosis

Presenter(s)

Jianning Shao, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Uncontrollable cell growth is a widely acknowledged hallmark of cancer. The tumor suppressor p53 promotes apoptosis (cell death) and may serve to alleviate this growth. However, p53 is normally inactivated in cells due to its interaction with mdm2; mdm2 can be degraded by ARF, which is stimulated (upregulated) by E2F1. This endeavor seeks to promote p53 mediated apoptosis by eliminating the negative feedback loop resulting from the p53-Mdm2 interaction. E2F transcription factor 1 will be overexpressed in selected cancerous cell lines to upregulate ARF. To achieve this overexpression, a pRcCmV vector will be used. E2F1 overexpression is hypothesized to lead to upregulation of ARF, thus freeing p53 from its binding with mdm2. Initially, the pRcCMV vector was transformed in competent bacterial cells. To harvest the DNA, a miniprep was performed; results are currently being analyzed. The long term goals for this project, however, are to confirm the interaction between ARF and Mdm2 and to utilize the chain reaction described above to promote p53 mediated apoptosis. There exists abundant evidence supporting the role of ARF in the degradation of Mdm2 as well as Mdm2's role in suppressing p53 mediated apoptosis. This particular study aims to investigate the chain reaction resulting from overexpression of E2F1.

C22

Identification of Dicer-1 and Dicer-2 Binding Proteins

Presenter(s)

Edward Song, Illinois Mathematics and Science Academy

Advisor(s)

Erik Sontheimer, Northwestern University

RNAi is a biochemical pathway that is important in regulating gene expression and defending against viruses. In short, a Dicer enzyme dices double stranded RNA (dsRNA) into small interfering RNAs (siRNAs) or microRNAs (miRNAs) and loads them into an RNA-induced silencing complex (RISC). siRISC and miRISC slice or translationally repress a target mRNA respectively. In *Drosophila melanogaster*, there are two versions of Dicer, DCR-1 and DCR-2. Some of the questions we are trying to answer are the following: What specifically binds to DCR-2 in whole flies? Do those proteins have a role in RNAi? What happens to DCR-2 interactions when flies are infected with an RNA virus? Using wild type flies and flies with a DCR-2 epitope tag, we tested whether or not proteins are degraded in extracts from whole flies due to digestive enzymes. Running the extracts in an SDS-PAGE gel, we performed different tests on the gel. While Coomassie staining shows the proteins are degraded, conversely, the silver stain indicates that the proteins are still intact. Most recently, the immunoblot for DCR-2 HA failed. If we can detect DCR-2 HA from whole fly extracts, an immunoprecipitation will be performed and all proteins that specifically bind to DCR-2 would be coprecipitated. Using mass spectrometry, those proteins can be identified. Engineering a fly with a tagged version of DCR-1 is another aspect of the inquiry, because it could allow for similar experiments involving DCR-1.

C23**Effective Negative Regulation by Suppressor of Cytokine Signaling 3 Produced by Treating Rat Retinal Müller Cells with Ciliary Neurotrophic Factor****Presenter(s)**

Shobha Topgi, Illinois Mathematics and Science Academy

Advisor(s)

Vijay Sarthy, Northwestern University Feinberg Sch. of Medicine

The cytokine ciliary neurotrophic factor (CNTF) is one of the most effective neuroprotective agents in the central nervous system. CNTF activates the JAK/STAT pathway to induce protein expression, which subsequently levels off due to negative control. One class of negative regulators is the suppressors of cytokine signaling (SOCS) proteins. To examine the temporal aspects of CNTF on SOCS3 gene expression and its relationship to the JAK/STAT pathway, two sets of experiments were conducted on the retinal Müller cell line, rMC-1. In the first set, cells were treated with CNTF for time points from 15 minutes to 90 minutes. In the second set, cells were transfected with a dominant negative STAT3 mutant prior to the treatment with CNTF. cDNA was generated from total RNA for use in quantitative real time PCR. In the first set of experiments, by 15 minutes treated cells showed a 2.5 fold increase of SOCS3 mRNA relative to the PCR internal control. By 30 minutes the level was more than 3.5 fold higher and by 90 minutes had returned to baseline. The dominant-negative STAT3 mutant appears to negate up-regulation of SOCS3 in response to CNTF. SOCS3 may be the main negative feedback regulator of CNTF activation of the JAK/STAT pathway.

C24**Examining Herpes Simplex Virus Type 1 (HSV-1) Entry by Live Cell Imaging****Presenter(s)**

Thiran Udawatta, Illinois Mathematics and Science Academy

Advisor(s)

Myung-Jin Oh, University of Illinois at Chicago

Deepak Shukla, University of Illinois at Chicago

Herpes simplex virus type 1 (HSV-1) affects an estimated 80 million Americans. HSV-1 entry can occur by endocytosis or by multiple receptor-ligand interactions, triggering fusion between the viral envelope and the plasma membrane, but is still a poorly understood process. Using an inverted live cell imaging microscope, virus/cell interactions were studied in real time. CHO-K1, MRC-5, HeLa, Vero, RPE, corneal fibroblasts, and human conjunctiva epithelium cells were used to document the interactions of HSV-1. Cells were imaged for 20 minutes prior to addition of the virus and then afterwards a green-fluorescent virus was added to track its interaction with the cell for 1 hour. Live cell imaging showed a phenomenon prior to viral entry that to this day has only been shown in RNA viruses. This phenomenon, called “surfing,” begins with a virion attaching to a branch like segment of the cell called filopodia and then traveling down to the cell body. This process allows the virion to get closer to the cell membrane and facilitate viral entry. Disruption of filopodia by underlying actin inhibits surfing and overall entry. A better understanding of filopodia and their role in surfing may provide insight to preventing future infections.

C25

Health and Disease in Medieval Britain

Presenter(s)

Ruijie Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Anne Grauer, Loyola University

Paleopathology refers to the study of disease in ancient populations. The purpose of this investigation is to determine and understand the broad spectrum of diseases that affected the people of medieval Britain. This has been done by constructing a database of pathological information extracted from published and unpublished archeological site reports. Forty-two site reports have been analyzed. Our preliminary results indicate that the medieval population suffered from a wide variety of maladies, which include, but are not limited to, spina bifida occulta, tuberculosis, malignant neoplasia, and Schmorl's nodes. Preliminary analysis of the data suggests that 7.80% of male adults suffered from spina bifida occulta compared with 6.45% of female adults; 0.79% of male adults displayed the effects of tuberculosis whereas only 0.26% of female adults were affected; 0.69% of male adults seemed to have malignant neoplasia compared to 0.46% of female adults; and Schmorl's nodes seems to have been more prevalent in men, with 33.74% of male adults affected compared to only 13.95% of female adults. This exploration has allowed us to see that medieval populations suffered from developmental conditions, bacterial infections, cancer, and conditions associated with trauma to the body. Ultimately, this research will be used as part of a larger comprehensive investigation about health and disease in medieval Britain.

C26

The Effects of Long QT3 Syndrome on Calcium Cycling in Cardiac Cells

Presenter(s)

Jiabo Zheng, Illinois Mathematics and Science Academy

Advisor(s)

J. Andrew Wasserstrom, Northwestern University Feinberg School of Medicine

The Long QT3 Syndrome occurs as a result of genetically-induced prolongation of sodium current (INa) decay, which causes an increase in action potential duration and intracellular Na. We used the toxin ATX II to mimic the effect of Long QT3 phenotype and investigated how slowing of INa decay affected cellular Ca²⁺ activity in myocytes of intact heart. Rat hearts were loaded with fluo-4AM on a confocal microscope allowing us to study intracellular Ca²⁺ cycling during INa prolongation. A low concentration of ATX II (1nM) was used to increase QT duration of the ECG. Prolongation of INa increased the magnitude of early Ca²⁺ basal transients, yet increased the likelihood of alternans at rapid pacing. This triggered activity was probably responsible for the arrhythmias that were triggered during rapid pacing in the presence of ATX II. Our data shows that the slowed INa induced by ATX II slows recovery kinetics of Ca²⁺ release causing the development of Ca²⁺ alternans at slower heart rates (sign of reentrant arrhythmias). ATX also causes intracellular Ca²⁺ overload, delayed after depolarizations DADs, and pacing-induced ventricular tachycardias. The induction of late INa causes irregularities in Ca²⁺ cycling, affects INa and the cardiac action potential, and may contribute to arrhythmogenesis.

D01**Analysis of Search Engine Marketing****Presenter(s)**

Elliot Margul, Illinois Mathematics and Science Academy

Advisor(s)

Sachin Agarwal, The Cono Project, Inc.

Search engine marketing (SEM) comprised 40% of the total \$16.9 billion spent on digital advertising in 2006. SEM is appealing to marketers because of the direct sales opportunities it provides. Therefore, I decided to find what makes a great SEM advertisement that attracts many customers. To find this, I conducted A/B testing using Google AdWords. I did the advertising for Dawdle, a video game/accessory marketplace, as it is a new business. Four ads were created to cover a large spectrum of digital advertising strategies. I ran two ads for 48 hours one week and the other two the next week. Afterwards, I compared the best ad from the first week to the second week. The fourth week, I made an ad that uses the information that I found to see if it is truly more effective. Currently we are still testing the ads and have found that there is not any significant difference between four of the main SEM strategies. Moreover, we are still in search of an advertising strategy that distinguishes itself in the data.

D02**Impact of Privatization on the Performance of Chinese Business Firms During the Late 1990s****Presenter(s)**

Margaret Tu, Illinois Mathematics and Science Academy

Advisor(s)

David Dranove, Northwestern University Kellogg School of Management

Once communism took over China in the 1950s, almost all business firms became state-owned. However, the performance of these state-owned firms was not as ideal as the government had hoped for, so they began looking for possible alternatives and stumbled upon the notion of privatization, the process of privatizing state-owned firms into privately owned businesses. This study determines the impact of privatization in China by comparing the performance of 123 privatized firms with the performance of 318 non-privatized Chinese firms from the year 1995 to the year 2001. Through my analyses, I found that there was no significant difference in the change in revenue from the year 1995 to the year 2001 between privatized and non-privatized firms and that the change in revenue was independent of whether or not a company privatized. This suggests that, based on revenue, privatization does not affect the performance of businesses in China. Data is currently being analyzed to determine whether the size of a certain firm is positively correlated with the success of privatization. Through further analysis, I will be able to answer such questions as: Will a larger or smaller firm yield a greater positive change in revenue? A discussion of the effectiveness of privatization in China may stem from the results of this study.

E01**Environmentally Benign Oxidation of Important Chemical Intermediates****Presenter(s)**

Sena Dzakuma, Illinois Mathematics and Science Academy

Advisor(s)

Horacio Olivo, University of Iowa

Green chemistry focuses on the design of chemical products and processes to eliminate hazards to human health and the environment. In the field of medicinal and natural products chemistry, oxidation reactions cause a majority of environmental detriment. Designing new methods that minimize the environmental footprint and the hazards of these reactions are the main objectives resulting in, the benign synthesis of chemical intermediates causing a minimal environmental detriment to the ecological world. The enormous amount of harm caused by oxidation reactions to the environment prompted us to investigate the development of a green chemo-enzymatic oxidation reaction of alkenes and sulfides. Methodology used for this development employs green chemistry principles including the use of an immobilized lipase. *Candida antactica* lipase, the biocatalyst, reacts first with the solvent, ethyl acetate, and hydrogen peroxide to generate peracetic acid *in situ*. The peracetic acid is utilized to oxidize alkenes to epoxides and sulfides to sulfoxides. Utilizing the chemo-enzymatic oxidation for the preparation of indene oxide is valuable for the synthesis of chiral catalysts. Chemo-enzymatic oxidation is also engaged in the preparation of an important sulfoxide, the synthesis of Modafinim. Modafinil is a new psycho stimulant devoid of any addiction liability. Characterization of organic compounds was determined by NMR spectroscopy.

E02**Zeolites and NO_x Reduction Reactions****Presenter(s)**

Andrew Groesch, Illinois Mathematics and Science Academy

Advisor(s)

Randall Snurr, Northwestern University

Zeolites, commonly used in the automotive industry, are hydrated aluminosilicate minerals that have a micro-porous structure capable of accommodating a variety of cations. In automobiles, harmful NO_x gases are produced so automobile manufacturers attempt to create catalytic converters to limit their release. In this research, the molecules in question were modeled using a program called Gaussian. A barium-exchange zeolite was chosen to act as a catalyst. There are multiple pathways for the reaction to progress, so tests were run to find the minimal energy requirements for each. This project deals with defining the energy changes for these reactions by 1) constructing the initial geometries for the intermediate structures and 2) optimizing the structures' geometries through analysis. We have found electronic energy for the intermediate structures previously stated. We then compared the relative energies of each pathway to find the minimum energy requirement for the reaction. Preliminary research indicates that the reactions, in the presence of barium, require less energy to progress on all potential pathways. These results could increase the efficiency of detoxifying NO_x gases with more effective catalytic converters in automobiles. This could significantly decrease the anthropogenic effect on the environment.

E03**Chemical Sensing Based On Optical Interference of Modified Anodized Aluminum Oxide Surfaces****Presenter(s)**

Yifei Huang, Illinois Mathematics and Science Academy

Advisor(s)

Hsien-Hau Wang, Argonne National Laboratory

Highly sensitive and selective chemical and biochemical detection systems are desirable although most current sensors require extensive amounts of time and complicated procedures. Our research aims to determine whether it is possible to make anodized aluminum oxide (AAO) highly sensitive by demonstrating a strong UV-Vis spectra shift while modifying its surface to attract target molecules. Ag was evaporated at 45 and 90 degree angles onto AAO samples grown by self-assembly through a two-step anodization process. The thin AAO (~20-400 nm), coated with a metal surface layer, exemplified strong and visible interference colors. We then soaked the samples in an ethanol/C₁₆H₃₃SH solution and attached thiol-molecules to Ag. At 45 degrees, we successfully allowed Ag to coat only AAO's surface, creating a hydrophobic top surface with hydrophilic wells. Hydrophilic particles were allowed to enter the wells. Using a spectrophotometer in reflectance mode, UV-Vis spectra were produced showing shifts and variation after adding Ag and C₁₆H₃₃SH. These alterations suggest that AAO properties can be successfully modified for efficient chemical sensing purposes.

E04**Methods for Carbon Nanotube Purification and Quality Analysis****Presenter(s)**

Andrew Nelson, Illinois Mathematics and Science Academy

Advisor(s)

Hsien-Hau Wang, Argonne National Laboratory

In recent years, nanotechnology research has uncovered many applications for carbon nanotubes (CNTs), owing largely to the nanotube's great mechanical strength and their unique chemical and electronic properties. Despite the great potential demand for these materials, however, no efficient method exists for supplying high quality CNTs in quantity. One possible solution is to use a second-stage purification method to produce better-refined nanotubes. Our efforts have focused on analyzing the effectiveness of a particular after market procedure. By suspending the CNTs in an organic solvent, inducing disruptive microbubble formation in the solution using ultrasonic waves, and finally separating the output using centrifugation, we hoped to force the contaminants—largely metals and amorphous carbon—to precipitate away from the desirable CNTs. We examined the post-treatment samples using atomic force microscopy, Raman spectroscopy, and performance of fabricated devices. By modifying environmental variables such as the sample temperature at the time of ultrasonication and the length of said treatment, we hoped to assess possibilities for improving the overall procedure and, hopefully, to offer possibilities for a final, practical method. Results show promise, although somewhat limited, for low temperature and moderately long (30-45 minute) ultrasonication treatment, and we have expanded our study to include both single-walled and double-walled CNTs.

E05**The Strong Electrostatic Adsorption Method for the Synthesis of Pt-Fe/SiO₂ Alloy Catalyst****Presenter(s)**

Erin Talbot, Illinois Mathematics and Science Academy

Advisor(s)

Randall Meyer, University of Illinois at Chicago

Bimetallic catalysts can exhibit unique activity, but often suffer from a lack of compositional uniformity. The ultimate goal is to create a uniform Pt-Fe/SiO₂ catalyst by the use of the strong electrostatic adsorption (SEA) method, which relies upon the principle that species of opposite charge will experience attractive interactions aiding in the adsorption process. Given the knowledge of the point of zero charge of the support material, a charged precursor can be directed to adsorb on the surface by carefully tuning the solution pH. This method has been successful so far in the creation of catalysts such as Co-Mn on SiO₂ and Pt on TiO₂. Work thus far on synthesizing a Pt-Fe bimetallic catalyst, includes adsorbing Fe₂O₃, since no suitable Fe complex was found, on the SiO₂ support using dry impregnation. Pt was then adsorbed onto the surface with chloroplatinic acid using the SEA method. Further attempts to make Pt-Fe bimetallic catalysts focused upon a novel method developed by collaborators at BP. With dry impregnation, iron nanoparticles were created on SiO₂ using iron nitrate and followed by the addition of one mole of citric acid per mole iron nitrate. The SEA method will then be used to adsorb Pt onto the Fe particles.

E06**Nylon and Minimal Surfaces****Presenter(s)**

Ruhiyyeh Turner, Illinois Mathematics and Science Academy

Advisor(s)

Vicki Burgholzer, Illinois Mathematics and Science Academy

The project's purpose was to attempt to create minimal surfaces out of nylon. I wanted to see if metal frames could be used to create a film that would create a shape that minimizes surface area. Creating the nylon only requires the use of two chemicals, but finding the techniques used to get a film on them and choosing a method for creating the metal frames required some effort. Aiming to create a disk or helicoid, a variety of results was found. Most of the creations were imperfect, since they had threads of nylon hanging on them, or holes would form as the nylon began to dry. Creating a disk, one of the simplest minimal surfaces, was fairly easy, though there were deformations. Creating a helicoid was more difficult, and in the process some interesting but unwanted shapes were created. Yet, the helicoids that were created had many ridges or holes in them. In order to fix that problem, the current goal is to try to changing the surface tension of my solution, along with trying to find out why holes form. The final goal is to create as accurate a minimal surface as possible.

F01**Through Their Eyes: Using an Eye-Tracking System to Improve Focus****Presenter(s)**

Katie Cruppenink, Illinois Mathematics and Science Academy

Advisor(s)

Jason Leigh, University of Illinois at Chicago

Yiwen Sun, University of Illinois at Chicago

The focus of my investigation has been the development of eye-tracking software that will be useful for more accurately evaluating the care of a person diagnosed with a learning disability. The software, written in C, will determine how much time a person is spending on-task, as well as the position of their focus, in comparison to a control group. With the help of my advisor, preliminary data, from a small sample group, has been gathered using the beta version of the software. Improvements continue with regard to extracting meaning and improving accuracy of the data. One such improvement allows the user to view the areas of the image where the subject spent the most time. Given our current data, we believe that our software will be a useful tool for the evaluation of the treatment of patients diagnosed with a learning disability. Additional data is continually being collected and analyzed from patients who have been diagnosed with a learning disability. A control group has not yet been formed for this study. It is hoped that, with the use of advanced eye-tracking software, the treatment of people suffering from a learning disability can be more accurately evaluated.

F02**Artificial Intelligence: Bridging the Gap Between Men and Machine****Presenter(s)**

Alexander Drummond, Illinois Mathematics and Science Academy

Kyle Hanson, Illinois Mathematics and Science Academy

Advisor(s)

Mike Ososky, Applied Computer Technology

For eons, men have hypothesized about the day when man made machines would be as intelligent as the most enlightened philosopher. Many argued that such an event would never occur, pointing to difficult games like chess, as well as the complexity of language. However, as recent times have indicated, the gap between machine-intelligence and human-intelligence has decreased significantly. The watershed moment for public perception of artificial intelligence was perhaps when Deep Blue defeated Grandmaster Gary Kasparov. How close are we to the first machine “smarter” than a human? What will happen once machines reach this intelligence threshold? By studying multiple primary source accounts from visionaries in the field of artificial intelligence, biology, and general computing technology, we have found multiple potential answers to these questions. The most intriguing of these theories is that of the Singularity. This is a hypothesized event where the rate of technological advancement is faster than humans can comprehend. At this point, the machines will have become separate entities from humans; the ramifications of the Singularity are astounding, and could change the course of human history.

F03**Solving Text-Based CAPTCHAs Using Skeletal and Edge Analysis****Presenter(s)**

Justin Johnson, Illinois Mathematics and Science Academy

Ilya Nepomnyashchiy, Illinois Mathematics and Science Academy

Jason Rock, Illinois Mathematics and Science Academy

Advisor(s)

Brian Sea, Illinois Mathematics and Science Academy

A CAPTCHA (completely automated public Turing test to tell computers and humans apart) is a methodology used on the Internet to prevent automated scripts from submitting malicious content. CAPTCHAs commonly take the form of distorted text that is difficult for computers to read; specific uses of CAPTCHAs are in online registration for email services or online forums. The difficulties inherent to solving text-based CAPTCHAs are common to many unsolved problems, such as handwriting recognition and computer vision. As a first step to breaking text-based CAPTCHAs, a system to generate text-based CAPTCHAs was created. Next, a powerful form of edge detection was implemented. The boundary of each object is then used to construct a skeleton that emphasizes its unique aspects. A set of critical points are chosen from the boundary and skeletal points. Matching the critical points of a CAPTCHA to a library of critical points allows for distorted characters and words to be identified. The short term goal of this method is to achieve recognition of single characters.

F04**MMORPGs: A Parallel Universe****Presenter(s)**

Cathy Li, Illinois Mathematics and Science Academy

Advisor(s)

Brian Sea, Illinois Mathematics and Science Academy

MMORPGs (massively multiplayer online role-playing games) are the new entertainment style for young and old. Although considered the new multi-million dollar enterprise of the new century, most MMORPGs on the market are free-to-play with optional pay-to-play features. With exploding production and maintenance costs, very few generate a profit. It has become vitally important for the life of the industry to attract the most customers and identify the most marketable extra features through various metrics systems. This project explores the different voting and rating metrics of existing MMORPGs and integrates them to rate seven randomly chosen games: new and old; renowned and unknown. Metrics used to rate them include a survey for aesthetics, bandwidth tests, minimum hard-drive space, RAM usage, and graphics requirements, the last three of which are found on the games' websites. Current results imply that graphics (aesthetics) will play an important role in attracting customers, but the actual game properties (such as prices for subscription and game play) will determine popularity and ability to retain players.

F05**Combining Computer Science with Biology: The Power of Perl****Presenter(s)**

Xuxuan Liu, Illinois Mathematics and Science Academy

Advisor(s)

Neil Smalheiser, University of Illinois at Chicago
Vetle Torvik, University of Illinois at Chicago

In recent years, many researchers and biologists have encountered the problem of analyzing massive amounts of DNA and RNA data. Archiving and organizing these sets of data can create problems; however, one can create a computer program that would do all of the grunt work in a matter of minutes and hours instead of days and weeks. In our project, we have created a program using the programming language, Perl, to separate certain attributes of RNA sequences from a text file and to organize it into a different format. From this process, I have learned about regular expressions, the difference between a compiler language versus an interpretive language, as well as understanding pieces of code in a computer program. As an extension, we intend to create a database using data sets of RNA sequences from different organisms. This data can then be formatted into a database where each row would be an RNA sequence and each row has different attributes associated with those sequences. The resulting project can then be used to analyze and trace the evolution of large numbers of organisms by measuring changes in their RNA sequences, rather than through taxonomy or physiological observations alone.

F06**Tabluntu: A Linux-Based Distribution for Tablet PC Users****Presenter(s)**

Guy Macarol, Illinois Mathematics and Science Academy

Advisor(s)

Scott Swanson, Illinois Mathematics and Science Academy

Open source software is an exciting alternative to expensive proprietary software. It offers the benefits of being easily changeable, free, and safe. A tablet PC Linux-based operating system is an important and useful tool for educators and students exploring the realm of open source. An operating system centered on tablet PC use will benefit the ease of using open source software in a one-to-one tablet program. I have created Tabluntu, based upon the Ubuntu flavor of Linux, in order to address this need for an effective open source system for tablet users. The operating system incorporates programs and tools necessary for the end-user to easily set up their tablet PC for communication with Linux. Unlike other operating systems available, journaling tools like Xournal and Jarnal are available from the first boot of Tabluntu. In the creation of Tabluntu, I immensely facilitated my knowledge of the inner-workings of a Linux system. The project is still underway, and will be ready for beta release in the summer of 2008. My operating system will be able to help teachers and administrators save money for where it matters most - education.

F07**netLasso and High Speed Network Analysis****Presenter(s)**

Jonathon Ronchetti, Illinois Mathematics and Science Academy

Advisor(s)

Jason Leigh, University of Illinois at Chicago

Sungwon Nam, University of Illinois at Chicago

Data transfer is getting faster and faster with the advancements of networking and the tools that manipulate it. The utilization of optical lines and switches enables data to be sent at rates in excess of ten gigabits per second. With the use of netLasso, a program I have helped test and develop over the past two years, I have tested a wide variety of wired networks, ranging in speeds from one gigabit per second all the way up to an optical network of ten gigabits per second. Through fine tuning the program and making the output easier to understand by presenting it in a simple yet informative way, the user can more easily determine how a given network is behaving. From the use of graphs and a new html output, it is much easier to see trends in networks. From the results of tests, it seems the fastest speed obtained by a given network averages a little short of the name network speed due to header, such as 950 megabits on a gigabit connection. The results of tests show that it is becoming easier and easier to create sophisticated and reliable networks across large distances that still retain high speeds.

G01**Investigating Momentum Effects in Presidential Fundraising Using Prediction Markets****Presenter(s)**

Ryan Angelotti, Illinois Mathematics and Science Academy

Ryan Wang, Illinois Mathematics and Science Academy

Advisor(s)

Emily Oster, University of Chicago

This paper argues that there is a relationship between individual campaign contributions and a candidate's perceived likelihood of winning. Unlike previous studies, which focus almost exclusively on polls, we incorporate prediction markets to measure a candidate's relative strength over a continuous time frame. Looking at data from the 1996 and 2000 elections, as well as pre-primary data from the 2008 presidential election, we find evidence in support of a momentum effect in presidential fundraising. Using OLS regression, we determine that a statistically significant relationship exists between the amount of money a candidate raises and their perceived chance of winning. Our results suggest that absolute perceived chance of winning, rather than slight changes in these perceptions, are more important to potential donors. We conclude that strategic considerations play a role in motivating individual contributors.

G02

The Economic Benefits of Early Childhood Intervention

Presenter(s)

Jeffery Ding, Illinois Mathematics and Science Academy
Bo Shi, Illinois Mathematics and Science Academy

Advisor(s)

James Heckman, University of Chicago
Rodrigo Pinto, University of Chicago

Children born into disadvantaged environments, poverty, single-parent homes, and so forth, have a much higher risk for social and economic failure. Evidence shows that post-school remediation programs such as public job training and GED certification do not rectify the affects of their childhood. We claim that instead of intervention later in life, early intervention programs are more effective and economically beneficial. In our investigation, we analyzed data from one such program called the Perry Program. In this program, children were randomly assigned to be in the treatment or control group. These children were then tracked and compared from age three up to age forty. From the comparisons, we show that while early intervention may not affect the cognitive ability (that is, IQ) of disadvantaged children, it does affect psychological traits, of which we use the Big Five model (agreeableness, conscientiousness, extraversion, neuroticism, openness to experience). These psychological effects result in many economic and social benefits to the individuals and society.

G03

The Economic Costs of Deploying Fast Reactors in the United States as a Climate Change Mitigation Measure

Presenter(s)

Yangbo Du, Illinois Mathematics and Science Academy

Advisor(s)

R. Stephen Berry, University of Chicago

Increased global concern about the adverse impacts of anthropogenic climate change has spurred a resurgence of interest in atomic energy. Fast reactors are becoming an option for developed and developing countries alike as part of sustainable energy policy, but currently face difficulties concerning technological readiness and economic cost. However, increasing the investment in advanced reactor technologies and attaching a price to carbon emissions could help overcome these obstacles. This report addresses the economics of commercially deploying sodium cooled fast reactors and lead-bismuth cooled fast reactors for providing low carbon base load electric power, coupled with onsite pyroprocessing facilities for spent fuel recycling. Reform of the nuclear regulatory and finance structure, a carbon cap and trade system, and reactor component simplification, all of which increase the economic competitiveness of fission power, are assumed as part of a large-scale fast reactor deployment scenario. At present, the average estimated costs of advancing fast reactor and closed fuel cycle technology to commercial level do not suggest an economic advantage for such technologies, but a fast reactor cycle has the potential to become economically competitive given the uncertainty of previous estimates and the possible learning curve in a large-scale deployment scheme.

G04**The Relationship Between International Students Gaining Higher Educations in the United States of America and the Economic Development of Their Native Economies****Presenter(s)**

Michael Paik, Illinois Mathematics and Science Academy

Advisor(s)

Pradeep Chintagunta, University of Chicago

My investigation has focused on the relationships and correlations between international students from China, India, and South Korea who have earned graduate degrees in the United States, and their impact on their native economies both indirectly and directly. I have examined the rising number of international students in the US for the past twenty years and have compared those to the economic development of foreign economies. I have tracked several different indications of economic growth for these three countries; I have created three separate profiles analyzing the gross domestic product (GDP), the GDP annual growth rate, the GDP per capita, the balance of payments (BOP), the capital formation, and the gross national product (GNP). I am comparing these figures with the data collected on the tertiary education enrollment, international net migration, and number of international students studying within the US. Preliminary data displays definite trends between the rising number of graduates and economic growth. In the past twenty years as the number of foreign students has greatly increased, their respective economies have developed exponentially. Further analyses will be pursued in order to examine more thoroughly the effect of an American education on a foreign-based economy.

G05**Effect of Air Pollution on Standardized Test Scores in Santiago, Chile****Presenter(s)**

Ellen Song, Illinois Mathematics and Science Academy

Advisor(s)

Sergio Urzua, Northwestern University

It has been noted in many scientific studies that pollution has a negative impact on quality of life. Lead in paint, for example, has been linked to decreased cognition among children. High levels of small air particles have been linked to respiratory diseases such as lung cancer. We decided to investigate the impact of air pollution on cognition in children. We searched for a possible link between the level of air pollution in eight municipalities (Santiago, Chile-Cerillos, El Bosque, Independencia, La Florida, Las Condes, Providencia, Pudahuel, and Santiago) and the corresponding math and Spanish standardized test scores of fourth grade school children. Relevant variables were controlled for, including socio-economic level of students, the type of school, and the education level of parents. Though we originally hypothesized that the mean pollution would have a significant impact on test scores, we determined that, instead, variation in pollution level had significant impact on test scores; each extra part per million of variation lowered both Spanish and math test scores significantly. High, but stable, levels of pollution would be less of a detriment to education than low, unstable levels of pollution.

G06**Trust Thy Neighbor But Not a Stranger****Presenter(s)**

Mark Xue, Illinois Mathematics and Science Academy

Advisor(s)

Min Sok Lee, University of Chicago

Two men are brought in for questioning as crime suspects and they are separated with no communication between them. They are faced with two choices: to confess or not to confess. The above describes the classical prisoner's dilemma and assuming rationality and selfishness, the optimal choice would be to defect. During my SIR investigation, I researched economic and experimental concepts. I learned concepts such as Nash's Equilibrium and human behavior. In addition, I learned proper experimental methods such as controlling the experimental environment and masking what the experiment actually tests for, by doing so, I will lower the variability of the data. I also researched other experiments performed on prisoner's dilemma. I studied the accepted prediction of several games such as dictator game, prisoner's dilemma, and ultimatum game. I chose to experiment with social distance and examined how participants behave in prisoner's dilemma as they learn more about their partner. In my experiment, I will conduct three treatments: pairing by random order, pairing by class year, and pairing by hall of residence. Each subject in this experiment will be paired with another participant in the same session; however, the participants do not know the identity of their partner. My hypothesis is that as social distance between the participants decreases, the probability of participants not confessing increases. I will conduct my experiment the week after spring break.

H01**IMSA on Wheels in Technicolor****Presenter(s)**

Theodore Atwood, Illinois Mathematics and Science Academy
Brian Flynn, Illinois Mathematics and Science Academy

Advisor(s)

Tracy Miller, Illinois Mathematics and Science Academy

IMSA on Wheels in Technicolor is a new traveling science show presented to elementary students in grades three through five. This newly developed presentation covers topic in optics and light composition, including reflections, refractions, and the colors of light. The collaborators, Brian Flynn and Tucker Atwood, designed this investigation to challenge the classical methods of classroom teaching and offer a more creative approach - a forty-five minute presentation to demonstrate identified key concepts. The research components include the creation of a new show and the assessment of student learning after the show. During the script creation phase, emphasis was placed on knowledge retention for the younger students. Therefore, the show is designed to suit different learning styles, such as competition, cooperation, visuals, or auditory. In the surveys, students are asked to respond two weeks later to questions concerning the main topics of the presentation. Ten shows were scheduled for this semester and three schools elected to participate in the assessment component. The successful goals of this research project include twenty-five percent (or more) audience knowledge retention of the three key concepts and ninety-five percent positive feedback from educators whom view the show.

H02

Inquiry-Based Learning for Fifth and Sixth Graders

Presenter(s)

Naomi Morphis, Illinois Mathematics and Science Academy

Advisor(s)

Michelle Kolar, Illinois Mathematics and Science Academy

Sarah Pfeifer, Illinois Mathematics and Science Academy

Inquiry-based teaching is a method of teaching that engages students with activities that encourage creative thinking and problem solving. Teaching is about nurturing a student's passion for learning and giving them the skills to pursue their interests. My project investigates the application of inquiry-based learning in order to maximize the subject retention of fifth and sixth grade students. I have researched how the inquiry process, activity formatting, levels of teacher involvement and questioning techniques affect the creative thinking skills and the retention levels of students. I visited two fifth grade classes and, with the help of several other IMSA students and my advisor, taught some of the curriculum that I have written. After each trip, I administered written surveys to measure student retention levels. The results have confirmed that the most important element of inquiry is engaging the students. I have found that elements of a lesson that help engage students are hands-on experimentation, teacher encouragement and teaching points that relate to their daily lives. My objective is to apply my findings to the writing of the Science Explorers summer program curriculum, which will include inquiry-based learning within each lesson. In the end, students who have more fun learn more.

H03

More Effective Teaching: Language in Context

Presenter(s)

Janelle Peifer, Illinois Mathematics and Science Academy

Advisor(s)

John Stark, Illinois Mathematics and Science Academy

All IMSA students, as well as most high school students, are required to study a second language. There are many different methods of teaching languages to students that range from memorization to immersion. My investigation focuses on how students learning a second language learn vocabulary. Throughout my study I have worked with different IMSA German classes to conduct research as to the role of context in learning vocabulary. All words must be learned in a context; however, the context varies greatly and the effectiveness of the teaching as well. A major question I looked at was the role of pictures as a context. When working with the classes, I had both groups read the same story and complete the same worksheet. One group was able to read the story with pictures and the other without. In the German 3 classes it was quite obvious that the group with pictures learned the new words better, however, the German 2 results did not follow this pattern. This can be due to experimental errors and I predict that my next tests will be able to isolate the error and produce results more fitting with what I would expect.

H04

Motivation, Neuroscience, and the Brain

Presenter(s)

Cari Peterson, Illinois Mathematics and Science Academy

Advisor(s)

Stephanie Marshall, Illinois Mathematics and Science Academy

Current neuroscience research has advanced our understanding of the brain in dramatic ways, but has not unlocked all of its secrets. Each new fragment of understanding and piece of the puzzle enables possible applications, particularly in the field of learning. Knowing that the brain is made up of billions of neurons and trillions of connections between these neurons has important implications for learning because learning can build new connections, strengthen old ones, and create new neurons. Imagine a classroom where teachers introduce information by connecting it to students' previous knowledge, experiences, and interests rather than in isolation, where connections make retention and recall far more likely. Through reading, analyzing, and discussing neuroscience research, I have found that by understanding new advances in neuroscience, as well as how the brain works and what affects the brain's attention and learning, particularly in relation to motivation and emotion, can help us understand what might be done to maximize the learning potential of every person. Emotion is one of the strongest ties to motivation, which is what fuels personal interest in learning. By applying emotion in ways to encourage personal motivation in students, learning, recall, and retention are much easier and more likely for everyone involved. Emotion can help improve learning systems and classrooms if it and the brain are understood properly.

H05

Toys and Games

Presenter(s)

Valerie Young, Illinois Mathematics and Science Academy

Advisor(s)

Claiborne Skinner, Illinois Mathematics and Science Academy

The daily life of early nineteenth century American children imitated adult life. A child's day mirrored an adult's: a full schedule of chores essential to daily life. Children were taught to work from a young age so they could help the family. To make chores seem less daunting and more enjoyable, parents would invent games or songs related to children's work, such as *Pop Goes the Weasel*. A weasel is a tool that was used to measure yarn and wool for spinning and weaving. The weasel would make a clicking sound or "pop" every two revolutions, and so the rhyme *Pop Goes the Weasel*. Toys of the time were representations of adult roles and trained kids for work. It is no surprise at the time that a child was considered to be a person that hadn't grown up yet, and the sooner they did, the sooner more work could be done. Kids today can gain an understanding of the past through knowing the importance of the growing up of children and how it relates to adults. Aligning with Illinois State Learning Standards, common toys and games were incorporated into a history curriculum for kids to learn about early nineteenth century Illinois.

I01**Constructing Economically Feasible Magnetically Levitating Trains****Presenter(s)**

Cameron Breedlove, Illinois Mathematics and Science Academy

Jessica Durden, Illinois Mathematics and Science Academy

Jae Kim, Illinois Mathematics and Science Academy

Adam Leemans, Illinois Mathematics and Science Academy

Bohao Liu, Illinois Mathematics and Science Academy

Shaine Strullmyer, Illinois Mathematics and Science Academy

Advisor(s)

David Workman, Illinois Mathematics and Science Academy

The purpose of this inquiry is to create and examine varying designs and fundamentals of maglev train systems that would retain the advantages of the Inductrack design while reducing the price of its implementation. We centered our work on the idea of optimizing the different variables present in Faraday's Law of Induction through experimentation to maximize the strength of our coils for repulsion. There are two main elements to our design, halbach arrays, special configurations of magnets that give increased strength, and coils for the track. We set up multiple experiments to determine what force the interaction between the two would give. These experiments included measuring the magnetic force of the arrays, running a current through the wire, and swinging a pendulum with a magnet over coils to measure change in force. We also created other designs for other parts of our maglev system, including modifying normal train tracks along with current track to decrease building costs. We have found that halbach arrays are both necessary for the design and also powerful. Furthermore, the design of the coils greatly affects the strength of the repulsion. Although there is great potential in our maglev modifications, it is too difficult for us to make them work on a small scale.

I02

Investigating Beneficial Robotics Mechanisms

Presenter(s)

Caitlin Bunt, Illinois Mathematics and Science Academy
Ricardo Gonzalez, Illinois Mathematics and Science Academy
Ekaterina Kononov, Illinois Mathematics and Science Academy
Scott Page, Illinois Mathematics and Science Academy

Advisor(s)

James Gerry, Illinois Mathematics and Science Academy

This investigation was a study of FIRST robotics drive systems through the use of models to predict the advantages and disadvantages of their full scale implementations. The research focused on answering the initial question of What attributes are valuable when precise manipulation is necessary, taking into account terrain and objectives? We researched, built, and tested four different drive systems using vex, and additionally built and tested three full-scale implementations. This investigation was documented through use of videos, photos, and CAD duplicates. After completion of the building phase we competed in an FRC regional, where many different drive systems were observed and our initial conclusions were confirmed. Beyond the investigation we have also presented our experiences and knowledge to students from other schools in an attempt to further the knowledge of the robotics field and FIRST competitions. The knowledge gained can be applied to future robotics challenges as well as providing a foundation for potential research.

I03

Studies of the Structures of the Channeled Si and Si/Ge Stressors in a 30 nm Field-Effect Transistor Using Synchrotron X-ray Diffraction Data and System Modeling

Presenter(s)

Steven Cai, Illinois Mathematics and Science Academy

Advisor(s)

Jin Wang, Argonne National Laboratory

We have developed a systematic methodology to interpret, from measured X-ray nanodiffraction patterns, the internal structure of a nanoscale field-effect transistor. Our theoretical frame models the device structure and calculates the cross section of the X-ray scattering from the modeled structure. By applying our frame to a 30 nm field-effect transistor, we were able to fit the theoretically calculated diffraction patterns to measured patterns. We found a tensile strain (along the surface normal) distribution in the 30 nm channeled silicon with a maximum value of 0.0104 and a compressive strain (along the surface normal) distribution in the SiGe stressors with a maximum value of 0.006. The Si-SiGe interface sustains the largest lattice strain and lattice bending. We were also able to map out the lattice strain distribution and the lattice bending distribution in the cross section plane of the device. This development provides semiconductor manufacturers a tool to understand the stress effect of SiGe on channeled silicon, the manufacture-processing-structure relation, and the structure-performance relation. Our technique for analyzing the transistors is unique and has not been attempted before. The development of the next generation technology (30 nm node) will benefit from our work.

I04**Designing, Building and Testing a Vertical Takeoff and Landing Aircraft****Presenter(s)**

Roy Fisher, Illinois Mathematics and Science Academy

Advisor(s)

Francisco Ruiz, Illinois Institute of Technology

This investigation deals with the design, construction, and testing of a new form of flying car that would be easy to fly while retaining the vertical takeoff and landing (VTOL) functionality necessary for such a vehicle. Our VTOL is a helicopter type design with dual, counter rotating blades. This design is meant to increase stability and ease of use by eliminating gyroscopic procession as well as the need for the tail. Since the two rotors' paths intersect, gears must be used directly above the motors to keep the blades in perfect alignment. By securing the VTOL and testing the motors, many problems arose involving those gears in our prototype. With the vibrations of the motors, the gears would separate and jump teeth causing the blades to no longer be synchronized. Our designs are being tested with the goal of permanently correcting this problem. The tested solutions include running the aircraft off one motor and building a plate with bearings between the two shafts right above the gears to hold them together. More work will be done in the following months to permanently correct that problem and move on to designing the body of the VTOL.

I05**Sewage Off-Gas-Driven Fuel Cells to Stimulate Rural Electrification****Presenter(s)**

Ray Gu, Illinois Mathematics and Science Academy
Sammy Nguyen, Illinois Mathematics and Science Academy

Advisor(s)

Herek Clack, Illinois Institute of Technology

Electrification of rural areas in Africa, Asia, and South America is vital for economic development, but traditional energy sources are highly polluting, require nonexistent infrastructure, and produce more power than needed for rural populations. Also, waste management in rural areas is highly undeveloped, posing major risk for the spread of disease. Our investigation focuses on designing a coupled anaerobic digester and fuel cell to produce power for such areas. Methane produced by anaerobic digestion would supply the fuel cell, while waste heat from the fuel cell would drive the digestion process. To show the feasibility of this system, a lab-scale anaerobic digester and fuel cell will be tested separately at various temperatures to determine their optimum operating temperatures. A preliminary literature search suggests that anaerobic bacteria thrive best at 37°C (mesophilic bacteria) and 55°C (thermophilic bacteria). Additionally, the currently most available fuel cell, the proton exchange membrane, operates at an average temperature of 80°C. A thermodynamic analysis will be performed after experimentation to determine optimal configuration in coupling the two systems. This investigation is still in progress at this time. After concluding this investigation, we hope to construct a larger scale system to address problems that may be encountered in real-life implementation.

I06**Life as an Architect****Presenter(s)**

Yoonjung Koh, Illinois Mathematics and Science Academy

Ariel Liu, Illinois Mathematics and Science Academy

Advisor(s)

Steve Vasilion, Vasilion Architects, A.I.A

Located in downtown Batavia, 206 Main Street has undergone numerous additions and renovations and has now outlived its usefulness. The current owner expressed interest in completely redesigning this underdeveloped, underutilized site. His visions include a mixed-use urban development with ample space for office, retail, and residential. Six students from the Aurora/Batavia area explored this hypothetical project. We brainstormed different ways to fulfill the owner's requests and drew up conceptual ideas. After several different plans, we decided to utilize underground parking and add retail on the same lower level. The first floor would include office units, and the second and third floors would include condominium units. With the owner and city's approval, we finalized our ideas in AutoCAD and fully developed a site plan with detailed layouts for each unit. Finally, we consolidated our project in a 3-D rendering of the final development.

I07**How We Learn From System Failures****Presenter(s)**

Jacob Maloney, Illinois Mathematics and Science Academy

Advisor(s)

Edward Swierz, Thorton Tomasetti

System failures occur when a small seemingly insignificant error results in a cataclysmic failure. Examples of these failures include the Chernobyl meltdown, the Challenger explosion, the Miller Park crane collapse, and many more. Through an investigation of these events, I determined how society learns from these failures and how we prevent them from re-occurring. I focused on learning the details of these failures by reviewing literature and conducting interviews with experts in the field. I categorized the types of errors responsible into two main categories, design error and situation related errors. Since the types of errors vary widely so do the methods to prevent their recurrence. I found that the large majority of design errors can be fixed through the improvement of safety codes and quality assurance/quality control (QA/QC) policies. However, situation related errors prove more difficult to fix due to their unpredictability. The best solution seems to be to improve procedures and training to minimize the possibility of error. My results show the importance of properly and ethically handling these system failures to insure they do not happen again. They also indicate the effectiveness of the current systems preventing these failures and their ability to adapt to new challenges.

I08**Physics-Based Sound Generation****Presenter(s)**

Martina Pillay, Illinois Mathematics and Science Academy

Advisor(s)

Neelesh Patankar, Northwestern University

Sound is the vibration of a medium caused by pressure waves that can be represented by sinusoidal functions. Physics-based sound generation is the production of sinusoidal waves by some physical system. The solution of this system gives a sinusoidal function representing sound waves that can be heard by using a computer program such as MATLAB. Today, sound recording, transformation, and reproduction have been well developed, but the production of sound using physical models and graphs is still unfamiliar. The properties of springs, masses, and dampers are used to solve systems using Newton's Laws. The solutions of these equations were applied to create a sine wave function. The equations were then input into a computer program called MATLAB, where the wave function could be viewed, and also converted into a .wav file and produced as sound. By manipulating the parameters of different equations, various types of sound can be generated. The implications of the relationship between physics and sound can be found in animation (for the general entertainment industry), understanding noise generation by underwater vehicles (of military interest), voice generation and rendering (useful in medical interests such as speech therapy or speech enhancement), and scientific relevance (understanding the implication of noise generation on fish prey-predator dynamics).

I09**The Purpose of the IL-131 Reconstruction Project in Lake County and Its Social and Economic Impacts****Presenter(s)**

Priyanka Prakash, Illinois Mathematics and Science Academy

Advisor(s)

Derek Johnson, HNTB Corporation

Donald Wittmer, HNTB Corporation

Our investigation examined the social and economic impacts of the IL-131 improvement project, as well as assessing its purpose and need. We followed the Environmental Assessment methods as delineated by the Illinois Department of Transportation, in addition to completing the required procedural documentation. We compiled a project mosaic and completed a historical buildings survey. Due to the rising population, employment, and traffic volumes, and several intermodal transportation facilities in the area, we determined that expansion is necessary. In our demographics assessment, we found that Beach Park contains a slightly larger minority population than Lake County. Several schools, parks, cemeteries, and churches are located within the project limits. Waukegan Fire Department #5, several industrial and waste facilities in Zion, and light residential and commercial areas in Beach Park and Wadsworth may be affected. The reconstruction must accommodate a proposed runway extension at the Waukegan Regional Airport. There will be few, if any, business relocations. Many of the buildings are more than forty years old and are potential historical structures. Our overall findings, however, indicate that few significant social or economic impacts will occur as a result of the IL-131 expansion, although further assessment may be required.

I10

Liquid Argon Purity Demonstration

Presenter(s)

Evan Rodrigues, Illinois Mathematics and Science Academy

Advisor(s)

Richard Schmitt, Fermi National Accelerator Laboratory

A time projection chamber is a specific apparatus for recording neutrino paths. Tracing paths through the pure liquid argon in these chambers can help reveal information about neutrino oscillation. Current liquid argon time projection chambers are purified by evacuation; therefore the container needs to be built strong enough to withstand evacuation. This project was concerned with demonstrating the possibility of purifying a liquid argon chamber without the use of evacuation. The conceptual design of the chamber had been completed, but many dimensions and aspects were still missing. Calculations involving the sizes of components were made. For example, the valves of the nitrogen heat exchanger were calculated to have a flow coefficient of 4.21 and .035. Following this, specific equipment and valves were chosen for purchase, such as the specific heat exchanger model and the valves that had the required flow coefficients. The next step will be to construct the chamber and test it, though this may not be possible in the near future because of budget constraints. The ability to purify liquid argon without evacuation will make liquid argon time projection chambers cheaper and more accessible since expensive tanks that are strong enough to be evacuated won't be necessary.

I11

Using Spectral Absorption Readings to Identify Tumors

Presenter(s)

Anisha Vyas, Illinois Mathematics and Science Academy

Advisor(s)

Xu Li, Northwestern University

The objective of my experiment was to observe tumors using Fourier domain optical coherence tomography and then create a method of tumor identification. A program was created in MATLAB to analyze results from the application WinSpec. Using this program, the tumor was plotted on an x, y, and z scale in order to determine what it looks like and its special properties. I found that tumors mainly absorb the yellow-green portion of the spectrum and absorb light in the top middle of the tumor. This information can be used to identify tumors. If a large scale Fourier-Domain Optical Coherence Tomography were to be performed on the body, it would be easy to determine what areas of the body have tumors. Scientists at Northwestern University have found that the normal human tissue absorbs red-yellow light, but testing is still incomplete. If this was proven to be true, there would be a difference between tissue and tumors. Thus, if this type of tomography were to be done on the human body, scientists could easily pinpoint the regions of the body that have tumors using the spectral absorption information.

I12

Application of Operations Research

Presenter(s)

Brandon Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Mark Daskin, Northwestern University

The purpose of the project was to search for areas in the real world to which the ideas and concepts of operations research could be applied. Dr. Daskin saw that improvements could be made to the Intersession scheduling process at IMSA. A network flow model for the problem was created. A program written in Delphi by Dr. Daskin had the capabilities to solve for near optimal solutions. Intersession was originally assigned by dividing the student body into seven different groups and going from there. But with this new program, the student body could be viewed and assigned as a whole. The heuristic value for looking at all the students together was a mere 2% from the best linear value while the optimal result from solving the problem as separate smaller ones obtained a heuristic value of over 25%. The student body (98%) received either their first or second choices. The biggest problems encountered came from students who were unable to fill in the forms correctly. This hindrance paved the way for the current task, which entails creating a web interface so that students can log in online and sign up for Intersession courses, which will hopefully eliminate the issues that came up. Future projects are up in the air and may involve anything that implements operations research.

I13

Wireless Location Based Road Tolling Application

Presenter(s)

Terence Zhao, Illinois Mathematics and Science Academy

Advisor(s)

Mark Carlson, Illinois Mathematics and Science Academy
James Zhao, TruePosition

The objective of the road-tolling project is to implement wireless location technology in a location-based road tolling application. Using wireless location technology, instead of radio frequency identification and manual fee collection, is the fundamental focus of optimizing the business aspect of road tolling. I compared various wireless location technologies including uplink time difference of arrival (UTDOA), and common gateway interface time of arrival (CGI TA). Based on accuracy test results, the median UTDOA location was 27.2 meters from the actual position and 1029.4 meters for CGI TA. Even though UTDOA had higher accuracy, the CGI TA method was both simpler and cheaper than processing the triangulation of location measurement units required by UTDOA. With focus on optimizing the system's capacity and cost, location methods and request controls were defined based on specific road configurations. Although performing CGI TA is sufficient when dealing with easily defined roadways, locating objects in proximity on parallel and intersecting roads requires the high accuracy abilities of UTDOA. Additionally, Based on the traffic data analysis and the estimated location request rate, the total locations per second for all vehicles on a given highway was determined to be 18.66 locations/second. The final system deployment configuration is still under evaluation but is expected to implement a combination of UTDOA and CGI TA.

J01**Writing Your Way to a Dystopian Novel****Presenter(s)**

Jennifer Byers, Illinois Mathematics and Science Academy

Advisor(s)

Michael Hancock, Illinois Mathematics and Science Academy

By exploring the creative processes of various authors through their own accounts, I've found that they begin by reading a wide array of fiction and nonfiction and immersing themselves in words, then meeting characters in their minds. They usually have notes, summaries, outlines, and thorough ideas of their characters and plots. They'll make up worlds and histories whose existence they either wish or fear for. They'll construct and they'll tear down. By doing this research, I have formed the base for my own creative work. Focusing on the dystopian novel, I read dystopian works, concentrating on and outlining their conventions in plot and character development. I extended all of my ideas to lengthy and detailed outlines to develop the short prose I usually write into what will be a full-blown book. While I constructed a novel, my own writing strengthened as I was forced to examine every inch of my style. The pace slowed, and I extended my descriptions while the characters matured and acquired intrinsic personalities. I got to play with humanity like a God with a purpose and take the first steps onto the rocky, foggy path towards writing a novel.

J02**Coauthoring a Novella: Fighting for Saoirse****Presenter(s)**

Jennifer McDormand, Illinois Mathematics and Science Academy

Meaghan Pachay, Illinois Mathematics and Science Academy

Advisor(s)

Michael Casey, Illinois Mathematics and Science Academy

The purpose of this project was to identify different means of collaborative writing and to evaluate them through experience. Four different styles were chosen: writing together, switching authors every hour, switching authors every day, and writing separately but simultaneously. A novella was written utilizing each of these, trading off every week. The novella is set in Troubles-era Ireland and centers on an excon man and the reformation of his character as a result of the people he meets and comes to care about, the most important of these relationships being a romantic one. Some observations made included the inefficiency of writing together, because there is a tendency to focus on minute details like word choice, so not much writing happens, the difficulty of merging two writing styles when writing separately, and the difficulty of combining different ideas when writing the same section separately. For the collaboration itself, it was discovered that compromise, respect, and a focus on the big picture were paramount to a successful working relationship. Having a partner also made the project more enjoyable, in that there was someone to celebrate with, someone to understand the difficulties; and another brain to produce ideas.

J03**D-503 and the Linguists: Language Control in Modern Dystopias****Presenter(s)**

Kyle Schirmann, Illinois Mathematics and Science Academy

Advisor(s)

Michael Hancock, Illinois Mathematics and Science Academy

More's *Utopia* has developed through the centuries, and today's occasional attempts at its creation are often met with failure. As Krishan Kumar writes, utopia may be "exclusively defined by its form of imaginative fiction." Were one to develop, such visions still tend to disintegrate into dystopias. Such societies require control structures beyond those of utopias or present day societies. A central control mechanism of these governments over their populace is language manipulation. The Sapir-Whorf hypothesis posits that thought and language are inextricably linked, so compulsory state languages result in a populace of a specific mindset preserving the inherent power structures between authority and the citizens. This government control is furthered with restrictions against free will, civil liberties, and media dissemination. For example, Orwell's *1984* mandates the use of Newspeak, a constructed language, to eliminate dissent within the Party; the protagonist of Zamyatin's *We*, D-503, speaks with mathematical precision. On the contrary, in Elgin's *Native Tongue*, subjugated women create the subversive Láadan language in a society where speakers of alien languages form the superior class of the linguists. Language manipulation allows the state or conversely, its citizens, to shape or reshape political hierarchies and ideologies in literary dystopias.

K01**The Conductors Baton: A Practical Approach to Orchestral Conducting****Presenter(s)**

Rachel Banke, Illinois Mathematics and Science Academy

Advisor(s)

James Priovolos, Illinois Mathematics and Science Academy

This year, I started learning the techniques and intricacies professional directors use to conduct an orchestra, specifically the conducting styles for the major musical eras. I began the semester with readings on the origin of the conductor and the orchestra. I continued my research by listening to recordings of orchestral pieces by Bach, Mozart, Haydn, Beethoven, Brahms, Debussy, Schoenberg, Berg, and Stravinsky and discovered that major changes in orchestration occurred due to social, technological, and political changes. Using my prior research, I have completed basic score analysis and identified major conducting considerations, especially stylistic subtleties. For example, I determined the necessary strength of my ictus, the size of my conducting "box," and the cues to give the orchestra based on the era and style of the piece. The highlight of this investigation is a concert in which I will conduct pieces by Bach, Beethoven, Brahms, Debussy, and Berg that demonstrate major stylistic differences in music composed between the Baroque Era and the twentieth century.

K02

An Analysis of Gustav Mahler's First Symphony *The Titan*

Presenter(s)

Kayla Campbell, Illinois Mathematics and Science Academy

Advisor(s)

Steve Rings, University of Chicago

Mahler's First Symphony, *The Titan*, was finished in 1894, and includes many elements from his *Songs of a Wayfarer*. His symphony was not just notes on the page. Mahler believed the symphony should express an entire world, and his pieces thus told stories. This project draws on a solid knowledge of music theory, including chordal structures, harmonies, and progressions traditionally used in eighteenth and nineteenth century tonal music. This also includes knowledge about intervals and the building of a chord. There are seven chords per scale, one for each note of the scale. There are several types of chords, which can be inverted to create a different sound within a piece. Mixture, the use of elements from the parallel minor in a major key and vice versa, is very important because Mahler used it in his symphony. I will continue to learn advanced theory as needed. To apply this knowledge, I will analyze *The Titan* by looking at local harmonies, broad harmonies, and exploring the ways in which Mahler incorporated his *Songs of a Wayfarer* in the symphony. This project contributes to the knowledge of tonal music, use of elements from other works, and the extra musical elements Mahler used.

K03

Film Production Inquiry

Presenter(s)

Alex Ma, Illinois Mathematics and Science Academy

Alan Shen, Illinois Mathematics and Science Academy

Timothy Truong, Illinois Mathematics and Science Academy

Advisor(s)

Audrey Wells, Illinois Mathematics and Science Academy

We started with the goal of producing a fiction film that would illustrate multiple genres, action, drama, and comedy. First we faced the challenges of scripting including writing collaboratively, rewriting frequently, developing character depth, and accommodating the three different genres. We learned that stories are not developed through one round of scripting, but through a continual rewriting process. The preproduction stage included research on lenses, filters, lighting equipment, camera techniques, and editing processes. Preproduction also involved finding royalty free music, contacting musicians, and casting. The remainder of the inquiry includes learning about directing angles and lighting in a scene, natural and fluid acting, and postproduction editing skills. Perseverance and flexibility have been important. We have needed to reshoot frequently because of inclement weather; scripting took longer than expected; and casting brought some unexpected changes. As a result, we have developed an eye for angles, lighting, and overall setup of scenes in movies. As improved actors, we have been learning to act fluidly and naturally so that we can intercut shots and retain continuity. As a group committed to creating a film, we have developed an appreciation for film professionals and the work that they do.

K04

Renaissance Art and Its Meaning

Presenter(s)

Lisa Peterson, Illinois Mathematics and Science Academy

Advisor(s)

Robert Kiely, Illinois Mathematics and Science Academy

Throughout this year, I have been researching the symbolism and iconography that may be found in Italian Renaissance art. My study has included color choice, style, and placement of figures, as well as symbols themselves in many paintings. An important part to my research was the realization that throughout the Renaissance, a consensus existed about what different animals and parts of nature signified. During that period, it was believed that God put everything in the universe for a certain didactic reason, and the people of the Renaissance believed that they understood such divine reason and incorporated it into art. So far, I have focused on the painting *The Birth of Venus* by Sandro Botticelli. If the painting is stripped layer by layer, the Christian influence used by Botticelli is evident. The placement of the figures in *The Birth of Venus* is reminiscent of many paintings of Jesus' baptism. Also, the colors and shading of the painting have their own meanings which can be figured out based on the ideas of what each color signified to the Renaissance artist. I am currently analyzing Botticelli's *Primavera*, which is rich in floral and natural symbolism.

K05

Beauty Counts: Mathematics in Art

Presenter(s)

Patricia Whittaker, Illinois Mathematics and Science Academy

Advisor(s)

Clay Sewell, Illinois Mathematics and Science Academy

Human beings favor symmetry in their partners, odd numbers in flower arrangements, and sets of twelve in the bakery. In small ways, math shapes the way we view our world and in particular beauty. From the European Renaissance onward, math has knowingly or not, been incorporated into great works of art. The golden mean, or Divine Proportion, was used by artists such as Velazquez in *The Adoration of the Magi* to accentuate subjects and create balance in design. I followed this emphasis on balance through portraits, political statements, and digital art. When considering the topic it is impossible to separate the golden mean from its ties to Fibonacci and fractals. Pursuing one eventually flows into another. The golden mean derived from the Fibonacci sequence is represented by an infinite spiral, which incidentally is a main characteristic of fractal art. Expounding off of the art observed and incorporating phenomena like phyllotaxis I created my own original works merging the two subjects. From Fibonacci in acrylic, to fractals in origami, spirals and an emphasis on balance emerged in my creations. Ratios and calculations adorn my sketches paying tribute to the inherent link between the concepts of math and the beauty of art.

L01**Transformation of the Meat Industry with Disregard to the Environment****Presenter(s)**

Mari Crook, Illinois Mathematics and Science Academy

Advisor(s)

Jim Victory, Illinois Mathematics and Science Academy

Over the last one hundred years the meat industry has been undergoing a fundamental transformation. Due to transportation improvements, the application of machinery to agriculture, and the spread of industrial integration, the meat industry has seen an unprecedented rise in livestock production and monetary growth. By the turn of the last century, control of the industry passed from the hands of many contributors to just a few large corporations. The large corporations produce 98% of all poultry in the United States and just four firms produce over 60% of all pork in the United States. The current behavior of the industry is the result of the mindset of these large corporations. Since they have grown to control the entire industry, they have the power to dictate all aspects of the market and confine livestock at high stocking density. Both of these practices are part of their systematic effort to produce the highest output at the lowest cost. By producing America's meat supply in industrial style factories, these large farms contaminate local waterways and the very air we breathe.

L02**The Motives of a Master: Galileo's Quest for Truth****Presenter(s)**

Lucas Delort, Illinois Mathematics and Science Academy

Advisor(s)

Robert Kiely, Illinois Mathematics and Science Academy

False information circulates every day concerning the work of Galileo. Elementary schools teach that Galileo attacked the Church with his new astronomy. This is not true. The story of Galileo is much more deep and complex than we know. Galileo studied during an era still dominated by Aristotelian philosophy. Thomas Aquinas united the conflicting Church and Aristotelian worldviews so as to have one unified approach to reason and revelations, 350 years before Galileo. However, the age of skepticism was beginning with men like Christopher Columbus, Martin Luther, and Copernicus challenging medieval world views. Galileo was making discoveries that he was convinced were completely true. His discovery of sunspots and the Moon's imperfections undermined the Aristotelian idea of a perfect, unchanging heaven. He believed his discoveries of the phases of Venus and Saturn's moons proved the heliocentric theory, which was false under Aristotle and the Church. These incongruities could not exist. The Church had their own truth. Galileo was tried for holding true what the Church called a "false doctrine." The trial of Galileo became one of the most famous and controversial trials in history. It was Galileo's goal to unite science and the Church to save both, to have his faith in God and his faith in the observable, the measurable - science.

L03

Comprehensive Overview of the Medical and Cultural Aspects of Green Tea

Presenter(s)

Tianyu Du, Illinois Mathematics and Science Academy
Alyssa Winans, Illinois Mathematics and Science Academy

Advisor(s)

Dave DeVol, Illinois Mathematics and Science Academy

For thousands of years, green tea has been a standard part of the Asian lifestyle. Our review of green tea focuses on these possible medical benefits, sorting scientific fact from common misconceptions broadcasted by popular media. Only recently has it been discovered that its active components, consisting of 60% polyphenols and 30% catechins, can aid in the fight against cancer, heart disease, and diabetes. Epigallocatechin galate (EGCG), the primary catechin found in green tea, plays a role in inhibiting tumor growth with its anti-oxidative properties. Polyphenols have also been used in the prevention of other diseases such as anthrax poisoning due to its ability to reduce free radical activity. In addition to our research on the scientific aspects of green tea, we have also reviewed the culture of green tea, its history and its influence on the modern world. Green tea has long been an integral part of Asian culture in China, Japan, and Korea, but it has also begun to proliferate in the West due to its possible medical benefits. Yet despite media misconception, experimental data on green tea have been incomplete, ambiguous and contradictory. Therefore, solid conclusions about the extent of its medical benefits cannot currently be made.

L04

The Effects of Fundamentalism on Women in Christianity and Islam

Presenter(s)

Caitlin Guerra, Illinois Mathematics and Science Academy

Advisor(s)

Kathryn Kadel, Illinois Mathematics and Science Academy

Since the 1920s, religious extremist groups in both Christian and Muslim faith have fought against modernization. The term fundamentalism was developed in the 1920s to describe these religious groups; and the term has been used ever since then. The focus is primarily on the United States for Christianity, and Iraq, Iran, and Saudi Arabia for Islam. I also decided to focus on the 1970s to the present day as the time frame to narrow down my project. My research began with reading Fatima Mernissi's book, *The Veil and the Male Elite: A Feminist Interpretation of Women's Rights in Islam*, as a framework. I also intend to bring on such recent issues as the Mormon cult in Nevada. I have defined fundamentalism as a belief that the text a religion holds sacred is taken literally by devoutly religious people; fundamentalism grows when a political, economic, or social tragedy occurs. This study will examine fundamentalist's backlash against modernization. I also hope to clarify international relations between the Middle East and the United States through the lens of fundamentalism.

L05

The Evolution of English Between Chaucer and Shakespeare

Presenter(s)

Bethliz Irizarry, Illinois Mathematics and Science Academy
Troy Nelson, Illinois Mathematics and Science Academy

Advisor(s)

Margaret Cain, Illinois Mathematics and Science Academy

The English language has developed over time, as we can see in the difference between the tenth century epic *Beowulf* and today's *Chicago Tribune*. Within these thousand years of linguistic evolution, certain periods have witnessed an acceleration of the change; the interval between the times of Geoffrey Chaucer and William Shakespeare was one of these. Significant and noticeable changes occurred in the meaning and usage of words. Syntax, for example, became more standardized and more secular writing occurred. Rhyme scheme also evolved over this period, becoming both more diverse and specific. However, some aspects of the language did not take on their early modern forms until after Shakespeare's death. For example, spelling was not at all standardized, and punctuation was used very differently until the eighteenth century. Some standardization did occur, but locally, and throughout the period, there were significant dialectical differences. This project documented the language's move from the form known as Middle English to a more recognizable early modern one.

L06

An Analysis of Gender Roles in Sixteenth and Seventeenth Century European Witch Trials

Presenter(s)

Shawna Roberts, Illinois Mathematics and Science Academy

Advisor(s)

Robert Kiely, Illinois Mathematics and Science Academy

During the sixteenth and seventeenth centuries, Europe had what has been widely understood as a sudden fear of witchcraft and magic, leading to the deaths of thousands of people, mainly women. To understand these trials one must first understand the Elizabethan idea of magic, which is quite different from our modern one. Through my in-depth investigation, I learned that Europeans of this era saw the world divided into a fixed system of corresponding hierarchies through which God controlled the material world. White magic was the knowledge of the hierarchy in an attempt to understand God, while black magic was used to manipulate the material world against God. I found, through my textual research, that the witch trials in Europe were often caused by the political and social constraints of the time, leading to an increased interest in white magic and an increased awareness of black magic, possibly brought on by the Protestant Reformation. I will continue my reading in order to further understand the role that gender played in both the craze and trials of sixteenth and seventeenth century Europe.

L07**Distant Thunder: The Battle Fields of Colonial Illinois****Presenter(s)**

Sanat Bhole, Illinois Mathematics and Science Academy
Luis Carbajal, Illinois Mathematics and Science Academy
Nina Gnedin, Illinois Mathematics and Science Academy
Thomas Vandiver, Illinois Mathematics and Science Academy

Advisor(s)

Claiborne Skinner, Illinois Mathematics and Science Academy

Many disregard the early history of Illinois as something for historical societies. In reality, the explorers and natives of Illinois proved agents of immense authority and consequence, directing the development of what would become our nation. That said, What actually happened along the Illinois River around 1680? It was this crossroads of culture, where trade policies of London and Paris were played out to the death and where men of God clashed with agents of the Crown. To this day, Illinois bears the names of many a past champion and rogue, though many don't know why. Tragic as their manipulation was, through archival work, document translation, and fieldwork their records helped reveal the fabrications behind Massacre Island, affirmed the absence of any starvation at Starved Rock, and illustrated the profound political repercussions surrounding the destruction of Kaskaskia. The Iroquois obliteration of the Illiniwik devastated the economic feasibility of North America for France, making way for an English expansion west. We have sifted through historical myths, narratives, and downright lies to authenticate the early history of this state, the ramifications of which were felt around the world.

M01**The Future of Intellectual Property****Presenter(s)**

Sanat Bhole, Illinois Mathematics and Science Academy

Advisor(s)

Joanna Gunderson, Kirkland and Ellis LLP

Globalization has made economics and business more balanced. However, in the process, intellectual property (IP) has become a difficult resource to protect. In my investigation, I examined IP law to determine the consequences of globalization on IP and to propose a solution that would stabilize intellectual property law in the future. By reviewing books and legal documents, I have understood the tribulations that IP faces and have synthesized a strategy that may prove successful. Among the many trials is the failure of specific nations to recognize intellectual property rights while others, such as those in the EU, forge new treaties and agreements. There is no single answer to the situation that our insights, ideas, and inventions are in, but one must realize that we are all human and intellectual property only advances the human condition. Our global goal, then, should be to promote increased protection as well as standardization of the legal practices so as to increase competition for the development of the "next big idea."

M02

The Death Penalty Worldwide

Presenter(s)

Tianyin Luo, Illinois Mathematics and Science Academy
Gokila Pillai, Illinois Mathematics and Science Academy

Advisor(s)

Sandra Babcock, Northwestern University

This investigation's goal is to create a website about the death penalty worldwide. Last year, we focused on obtaining a basic understanding of capital punishment in a global context. To do so, we gathered data for retentionist countries in Africa and Asia. We utilized governmental sites, organizations, and articles pertaining to the death penalty as a basis for research. Examples of specific data found includes: crimes that the death penalty is applicable to, conditions on death row, racial and ethnic composition of death row, and clemency processes utilized. Through our research, we noticed many cultural, geographical, and political trends. Since then, we have supplemented and verified the information we have for each country. We continue to work on furthering our comprehension of the death penalty internationally. We expand our information base by contacting lawyers and organizations in retentionist countries to gather information not available elsewhere. After increasing our basic knowledge of the death penalty and its effects on international law, we have discovered that the death penalty is currently undergoing much reform and evaluation in several countries, hopefully for the better.

M03

Gender Based Persecution as a Ground for Asylum: Establishing a Social Group

Presenter(s)

Sylwia Matlosz, Illinois Mathematics and Science Academy
Ashima Sarup, Illinois Mathematics and Science Academy

Advisor(s)

Beatriz Sandoval, Hughes, Socol, Piers, Resnick, Dym Ltd.

During the past decade, one of the most significant challenges in refugee law has been applying the international definition of a refugee to provide political asylum fairly and consistently to battered women fleeing countries where little or no protection is provided. The definition of a refugee offers protection and immigration status to those who demonstrate a well founded fear of persecution based on race, religion, nationality, political opinion, or membership in a particular social group. Gender based claims are typically associated with persecution because of membership in a social group, but may also fall under the other grounds. Through means of literature review, we sought to compare the asylum policies of the United State to those of three nations with high asylum retention rates and gender sensitive asylum policies: Canada, South Africa, and the United Kingdom. These three countries have brought clarity to their policies, declaring that victims of gender persecution, unprotected by their state, can qualify for asylum as members of a particular social group, whereas the United States recognizes gender as a social group only in limited contexts. By analyzing legal decisions such as *Matter of R-A-*, we observed that in the US, ambiguous definitions of what constitutes a social group and the requirement of a strong connection between the persecution and membership have led to inconsistent rulings, leaving women applicants without legal protection.

M04

Crime Rates Over Twenty-Five Years: Aurora Versus Illinois

Presenter(s)

Colin Phillips, Illinois Mathematics and Science Academy

Advisor(s)

Robert Kiely, Illinois Mathematics and Science Academy

This inquiry investigates the changes in crime index rates from 1980 to 2005 between Aurora and the state of Illinois. Preliminary research focused primarily on contacting by telephone local institutions, such as the *Aurora Beacon News* and the Aurora Police Department, for assistance in obtaining census records and crime statistics for Aurora. These statistics would determine whether or not there was a significant increase or decrease in crime index rates as the years progressed, and, using these statistics, hypotheses of what formulated data charts and analyses would reveal were quickly developed. Initial results indicate that both total violent and property crimes have decreased over time, especially within the twenty-first century; however, from 1980 to 2005, Aurora has consistently had a greater number of total property crimes than the Illinois average. A correlation analysis shows a statistically significant negative correlation between years and the total property crimes for both Aurora ($r=-0.895$, $df=8$, $P=0.05$) and Illinois ($r=-0.900$, $df=8$, $P=0.05$). Illinois had more total violent crimes than Aurora up until the twenty-first century. Neither Aurora ($r=-0.329$, $df=8$, $P=0.05$) nor Illinois ($r=-0.535$, $df=8$, $P=0.05$) has a statistically significant correlation between total violent crimes and years. Could this recent increase of crimes in Aurora compared to Illinois be linked to the two distinct socioeconomic groups in Aurora?

N01

On an Approach for Van der Waerden Numbers

Presenter(s)

Je-ok Choi, Illinois Mathematics and Science Academy

Advisor(s)

Yon-Seo Kim, University of Chicago

Ramsey theory is a study of combinatorial objects in which a certain degree of order must occur as the scale of the object becomes large. Although the graph has been the most commonly used mathematical object in Ramsey theory, the basic structure of the integers was also revealed by Dutch mathematician B. L. van der Waerden. For any given integers $k, r \geq 2$, there exists a least positive integer $w=w(k;r)$ such that for all $n \geq w$, for every r -coloring of $[1,n]$ there is a monochromatic arithmetic progression of length k . However, due to numerous possible r -colorings of $[1,n]$, only a few nontrivial values of $w(k;r)$ are known. This inquiry studied the different algorithms of computing van der Waerden numbers and improved them by confirming the validity of a coloring more efficiently. Instead of checking the monochromaticity of every arithmetic progression in $[1,n]$, the sums of differences in integers with the same color for each partition were compared.

N02**History of Tangents From Apollonius to Cauchy (262 B.C.E. ~ Present)****Presenter(s)**

You Na Oh, Illinois Mathematics and Science Academy

Advisor(s)

Richard Wilders, North Central College

Contrary to people's most common belief today that calculus was invented by Newton in the 1600s, the development of calculus has been a long, gradual process since the early Classical Greek Era around 300 B.C.E. This investigation specifically examines the various mathematical methods of finding tangent lines throughout history, based mainly on the works of Apollonius, Descartes, Galileo, Newton, Leibniz, Euler, and Cauchy. This research also briefly discusses how different methods throughout different time periods have reflected historical and cultural beliefs of the time. From Apollonius's early geometric methods for finding the tangents of conics to our modern, purely algebraic methods for computing derivatives, this investigation will also reveal how the methods for finding tangents have evolved from geometric perspectives to algebraic perspectives. Surprisingly, this research shows that in certain cases, the previous geometric methods of finding tangents are much more efficient than today's method of computing derivatives. By observing this pattern of changes and the historical aspects behind the development of techniques for computing tangent lines, we gain a brief glimpse at the history of calculus.

N03**A Number Hiding Game****Presenter(s)**

Eric Shyu, Illinois Mathematics and Science Academy

Advisor(s)

Mark Fischler, Fermi National Accelerator Laboratory

We investigate a variety of number hiding games. One of the most basic of such games is as follows: player A chooses an integer on the interval $[1, N]$. Player B repeatedly guesses the number, paying one unit per guess and receiving information whether the guess is too high or too low (or exact, in which case the game ends). The hider is also assumed to be an adversary attempting to maximize his own payoff. This significantly complicates the finding strategy from being a simple binary search. We provide closed forms for some of the optimal strategies and game values for various values of N , which allows one to predict the optimal hiding strategy. The advantage conveyed relative to playing against a random hiding adversary appears to fluctuate with peaks at $N=2^k-1$. We provide insights concerning the optimal finding strategies. We also discuss a modification of the game in which the adversary is able to lie once. This clearly complicates the hiding and finding strategies at even low values of N .

N04

Probabilistic Analysis of Yahtzee

Presenter(s)

Justin Troyka, Illinois Mathematics and Science Academy

Advisor(s)

Micah Fogel, Illinois Mathematics and Science Academy

Yahtzee is a game that involves rolling five dice and trying to obtain specific patterns over several rounds, in order to get a high score. This study hoped to determine an optimal strategy for Yahtzee. Winning the greatest number of games is better than maximizing the average score over several games. One strategy may win four out of five games by a small margin, while another may win one game by a large margin. The former strategy would be better than the latter, because it wins more games. Several problematic situations in Yahtzee were analyzed so that when they arise they may be dealt with appropriately. These situations include the choice between an upper section box and a three or four of a kind; the choice between an upper section box and a straight; and the relative importance of a full house and three or four of a kind. The best course of action in each situation depends on several factors such as the other empty boxes on the scorecard, how far the game has progressed, and the values of the dice. Hopefully this study can serve as a foundation for a detailed long term analysis in the future.

O01

The Role of Histology in Response to Chemotherapy and Impact of Radiation on Outcome in Pediatric and Adolescent Hodgkin's Lymphoma

Presenter(s)

Dimple Adatia, Illinois Mathematics and Science Academy

Advisor(s)

James Nachman, University of Chicago

Standard treatment for pediatric Hodgkin's disease includes chemotherapy followed by radiation. However, it is unclear whether patients achieving complete responses to chemotherapy require radiation. There are three major types (histologies) of pediatric Hodgkin's disease: nodular sclerosing (NS), mixed cellularity (MC), and lymphocyte predominant (LPD). The influence of histology on complete response rate, relapse rate, and benefit of radiation therapy after complete response were examined by reviewing patient records (535 NS, 146 MC/LPD). There was no statistically significant difference in complete response or relapse rates of MC and LPD, so they were combined and compared against NS. Patients with NS had significantly higher failures to achieve complete response (21%) compared to patients with MC or LPD (9.2%, $p < 0.001$). Patients with NS had a significantly higher relapse rate (19.2%) compared to MC or LPD patients (4.9%, $p < 0.01$) when given chemotherapy alone. Patients with NS showed significantly higher relapse rates when treated with chemotherapy alone compared to chemotherapy and radiation, contrary to MC/LPD patients. We conclude that MC and LPD are more sensitive to chemotherapy due to their higher complete response rate and lower relapse rate compared to NS. Patients with LPD/MC histologies who attain a complete response should receive chemotherapy without radiation.

O02**Sickle Cell Disease: The Association of Blood Platelet Count on the Severity of the Disease****Presenter(s)**

Oluwakemi Aladesuyi Arogundade, Illinois Mathematics and Science Academy

Advisor(s)

Robert Labotka, University of Illinois at Chicago

Sickle cell disease, an inherited disorder caused by a functionally abnormal hemoglobin, affects millions of people across the world; about 80,000 to 90,000 Americans live with the disease today. When red blood cells in the circulation release their oxygen to body tissues, the sickle hemoglobin begins to polymerize, distorting the cell until it can barely function. This can cause severe complications such as pneumonia, stroke, and splenic sequestration in those with the disease. The function of platelets may contribute to the severity of sickle cell disease. This project investigated the possible correlation that may exist between platelet counts and the severity of the disease. Lab data such as the platelet count, white blood cell count, reticulocyte percent, and hemoglobin levels were gathered from the charts of over forty sickle cell patients under twenty-six. The number of hospitalizations, severe pain crisis, blood transfusions, and other complications were also gathered from the charts as measure of the severity of the disease. Currently, no significant statistical correlation has been found in analyses run with the data. However, the data have suggested some weak associations. As this investigation continues, more analysis will be performed on the data.

O03**The Effects of Caffeic Acid on Breast Cancer Cells****Presenter(s)**

Neelam Balasubramanian, Illinois Mathematics and Science Academy

Advisor(s)

Donald Dosch, Illinois Mathematics and Science Academy

Caffeic acid, a naturally occurring phenolic acid found in honeybee propolis, coffee, and a variety of fruits and vegetables, has been shown to have anti-oxidant, anti-inflammatory, and anti-carcinogenic properties. In order to study its effects on breast cancer, MCF-7 cells were grown with concentrations of caffeic acid added varying from 0 to 200 $\mu\text{g}/\text{mL}$. Cell death was observed proportional to the concentration of caffeic acid added. Western blot analysis for caspase-3 activity is ongoing to suggest a mechanism for apoptosis through NF- κ B inhibition. Previous studies have shown that humans can absorb caffeic acid from their diet. Since caffeic acid induces cell death, a change in diet to include everyday foods such as honey and coffee could help provide noninvasive prevention and treatment of breast cancer.

O04**Rapid HIV Testing in the University of Illinois at Chicago Emergency Room****Presenter(s)**

Jorge Jeria, Illinois Mathematics and Science Academy
Arika Verma, Illinois Mathematics and Science Academy

Advisor(s)

Richard Novak, University of Illinois at Chicago

Due to a high HIV incidence rate in the United States which has failed to decline within the past decade, the CDC recommends HIV testing for every patient in all health care centers. The newly developed OraQuick ADVANCE™ Rapid HIV-1/2 Antibody test allows HIV testing to be completed within twenty minutes in a noninvasive manner. Our goal was to design a protocol to institute rapid HIV testing in the University of Illinois at Chicago (UIC) emergency room. In order to successfully carry out this project, we compared similar experiments done in other healthcare facilities by looking at aspects such as administration of testing and pre/post test counseling. Through this examination, a standard operating procedure was developed. Currently, we are in the process of reviewing experimental procedures and hope to have results by the end of April. If a high prevalence rate is found, UIC may establish a permanent universal HIV screening program as part of its emergency room admission procedures.

O05**Overexpression of Aquaporin-1 in Non-Small Cell Lung Cancer****Presenter(s)**

Sushma Kola, Illinois Mathematics and Science Academy

Advisor(s)

Anjana V. Yeldandi, Northwestern University Feinberg School of Medicine

The aquaporins are newly discovered channel proteins that regulate water transport across cell membranes. Since most tumors exhibit high vascular permeability and interstitial fluid pressure, a possible role of aquaporins in tumor angiogenesis, growth, and spread has been suggested. The purpose of this study was to investigate the expression of aquaporin-1 (AQP-1) in various types of lung cancers (52 adenocarcinomas, 12 bronchoalveolar carcinomas, 25 squamous cell carcinomas) by immunohistochemical staining. Tissue microarrays (TMAs) of lung cancers were stained with AQP-1 antibodies to identify expression of AQP-1 in non-small cell lung cancer. Results of this study demonstrate a significant correlation between AQP-1 expression and histologic subtypes of lung cancer. AQP-1 was overexpressed in 69% (36 of 52) and 67% (8 of 12) of adenocarcinomas and bronchoalveolar carcinomas respectively, compared to only 36% (9 of 25) of squamous cell carcinomas ($P = 0.0049$). Only 33% (2 of 6) of normal lung tissue overexpressed AQP-1, compared to 60% (60 of 100) of all lung cancer tissue studied ($P = 0.1941$). Although further details on the molecular function of AQP-1 related to tumorigenesis remain to be elucidated, the results suggest a potential role of AQP-1 as a novel therapeutic target for the treatment of lung cancer.

O06

Treatment of Breast Cancer Using an Oncolytic Adenovirus to Inhibit the Transforming Growth Factor- β Signaling Pathway

Presenter(s)

Bob Lee, Illinois Mathematics and Science Academy

Advisor(s)

Janhavi Gupta, Evanston Northwestern Healthcare Research Institute

Prem Seth, Evanston Northwestern Healthcare Research Institute

This investigation explores a novel approach to curing breast cancer that utilizes the natural functions of human body cells and viruses. The TGF β signaling pathway regulates the growth and development of normal cells and is also crucial for the progression of downstream metastasis of the cancer cells. To take advantage of this key factor, a virus Ad.sT β RFc (containing p01/07sT β RFc, a genomic plasmid that inhibits the functioning of the TGF beta signaling pathway) was engineered. This mutant adenovirus can replicate itself in any type of cancer cell irrespective of the genetic defects that cancer cell possesses. It is hypothesized that the engineered adenovirus Ad.sT β RFc will lyse the cells and simultaneously produce the sTGF β RIIFc protein which will bind to TGF- β 1, disrupting the downstream signaling pathway and subsequent development of metastasis of the cancer cells to bone. To test this hypothesis the virus was injected into tumor bearing mice and the tumor volumes were measured for twelve weeks. More than 85% of the tumor bearing mice injected with the virus showed tumor regression. Expanding upon these results, Ad.sT β RFc has a great potential as an antitumor agent.

O07

Molecular Events in Inflammatory Bowel Disease: Cytokine Dependent Activation of Epithelial Myosin Light Chain Kinase

Presenter(s)

Yue Lu, Illinois Mathematics and Science Academy

Advisor(s)

W. Vallen Graham, University of Chicago

Jerrold Turner, University of Chicago

In inflammatory bowel disease, the intestinal epithelial barrier is often disturbed. Inflammatory cytokines such as tumor necrosis factor (TNF) activate myosin light chain kinase (MLCK), resulting in MLC phosphorylation and actomyosin-dependent actin contraction. These events cause changes in intestinal epithelial permeability that reduce the barrier function. We hypothesize that MLCK activity can be directly targeted by a small molecule drug, FK506, that would decrease MLC phosphorylation and TNF-induced MLCK-dependent barrier regulation. FK506 is known to inhibit immune cell activation. However, the direct effects on the epithelial barrier have not been characterized. This investigation focuses on measuring the effect of small-molecule drugs on epithelial permeability through electrical resistance and MLC phosphorylation levels through Western blot techniques. Applying TNF to epithelial cell monolayers *in vitro* induced a 15% drop in electrical resistance which could be reversed to 99% of control levels with 100 μ M FK506. To understand the effect of FK506 on MLCK activity, we experimented with different blotting conditions. We will ultimately be able to quantify the effect of TNF and FK506 on MLCK activity. Understanding the molecular events in MLCK activation may allow rational design of therapeutics to correct the imbalances in diseased states.

O08

Walking with a Robot: Correlation Between Post-Stroke Recovery Function and Training Performance Values

Presenter(s)

Anita Mehta, Illinois Mathematics and Science Academy

Advisor(s)

David Brown, Northwestern University

A stroke is a loss of brain function due to an interruption in the blood supply to all or part of the brain. One hemisphere of the brain controls the movement of the contralateral side of the body. For this experiment, twelve stroke patients used the KineAssist, a machine developed to help people practice walking while recovering from a stroke, to perform three different training tasks: ten meter sprint, tandem walking, and step-onto-step test. The data collected from these three aforementioned tasks was compared to the data of each subject's Berg Balance Test Score and Fugl-Meyer Motor Recovery Score to determine whether or not there is a correlation between functional recovery and training task performance. Results are still being calculated at the time of the writing of this abstract. This study will demonstrate the extent to which training performance is correlated with motor and balance recovery post stroke.

O09

Evaluation of Ultrasensitive p24 Antigen Assay as an Alternative to Standard Viral Load and Antigen Assays in Diagnosis and Patient Treatment Monitoring

Presenter(s)

Vineet Mohanty, Illinois Mathematics and Science Academy

Advisor(s)

Bill Kabat, Children's Memorial Research Center

The standard for HIV detection during antiretroviral (ARV) therapy monitoring is the HIV-1 viral load. However, this requires skilled technicians and dedicated laboratory resources, hindering its implementation in resource limited settings. An alternative method, the ultrasensitive p24 antigen assay (Up24), was evaluated for infection-detecting efficiency in plasma samples from patients undergoing ARV therapy. Samples underwent three assay treatments: standard p24 non-immune complex disruption (NICD), p24 ICD detection, and Up24, with the sensitivity and detectable antigen quantities of each compared to evaluate efficiency. ICD and Up24 differ from NICD because both employ a short boiling period following acid addition to samples, which, theoretically, minimizes damage to the p24 antigen during antigen/antibody separation than the NICD method of acid addition and half-hour incubation. Preliminary results of 34 samples, using NICD and ICD, show 15 samples initially reactive (IR) and 19 non-IR (NIR) samples from the NICD assay, as opposed to 5 IR and 31 NIR from the ICD assay, suggesting sensitivity variations between both assays. Twenty three samples were found to have higher detectable p24 antigen quantities following the ICD protocol compared to the NICD assay, confirming that damage to p24 antigen is minimized by boiling following acid addition versus incubation. At this stage, Up24 assays are still being conducted on samples. Results will be stated and discussed further in this paper.

O10

The Phantom Inside

Presenter(s)

Solomon Nittala, Illinois Mathematics and Science Academy
Gaurav Singh, Illinois Mathematics and Science Academy

Advisor(s)

A. Vania Apkarian, Northwestern University Feinberg School of Medicine

This project focuses on phantom limb pain, pain that amputees experience on a limb that is no longer physically part of the body. The purpose of this project was to identify which areas of the brain become particularly activated during chronic phantom limb pain. To accomplish this purpose, we took functional magnetic resonance images (fMRIs) of a patient's brain as he experienced the pain. The subject then underwent heat therapy, in which heat was applied to his phantom limb and the control, or non-amputated, arm. Throughout the study, subjects rated their pain on a scale of one to ten (one being minimal). Results indicate that patients experienced pain on the control arm with heat therapy but did not experience increased pain when heat was applied to the phantom limb. This indicates that nerve endings have been severed, which have in part caused the constant perception of pain. fMRI images indicate that activity is mainly found in the cyrus occipitalis medius and the cuneus portions of the brain during the pain. These results are significant for the scientific community at large so better treatments can be developed and suffering may be eased for limb pain amputees.

O11

Pigment Epithelium-Derived Factor Inhibits Angiogenesis by Activating C/EBP α to Induce Cell Cycle Arrest in Endothelial Cells.

Presenter(s)

Karan Patel, Illinois Mathematics and Science Academy

Advisor(s)

Olga Volpert, Northwestern University Feinberg School of Medicine

Pigment epithelium-derived factor (PEDF), a potent angiogenic inhibitor, utilizes transcription factors to inhibit angiogenesis in endothelial cells. Peptides were created from two of PEDF's functional epitopes. The 34-mer peptide, (amino acids 24-57), is known to block angiogenesis, while the 44-mer peptide, (amino acids 58-101), is known to sustain it. This study tested the effects of PEDF, 34-mer, and 44-mer in endothelial cells treated with the angiogenic growth factor vascular endothelial growth factor (VEGF). With the use of protein/DNA arrays, we found several transcription factors that were regulated by PEDF and the peptides. We focused on the transcription factors retinoblastoma (Rb) and CCAAT/enhancer binding protein alpha (C/EBP α), and studied them using Western blots, RT-PCR, and ELISAs. Rb is a cell cycle regulating protein that functions at the G1/S checkpoint and inhibits cell cycle progression when unphosphorylated; C/EBP α inhibits kinases that phosphorylate Rb and thus inhibits cell cycle progression. In our experiments, we showed that PEDF and 34-mer treatments increase Rb and C/EBP α concentrations while decreasing phosphorylated Rb concentrations in cells and leading to an inhibition of endothelial cell cycle and angiogenesis. Furthermore we found that PEDF and 34-mer utilize the intracellular signaling protein JNK1 to activate C/EBP α . Next, we will be confirming that PEDF and 34-mer treatments cause cell cycle arrest by using flow cytometry.

O12**The NICHE (Non-Invasive Cardiac Hemodynamic Evaluation) Study****Presenter(s)**

Suganya Rajendran, Illinois Mathematics and Science Academy

Advisor(s)

Antony Kim, University of Chicago

The current standard for right heart pressure measurement is right heart catheterization (RHC), a procedure which provides information that could predict heart failure. While this procedure is reliable, it is also invasive and sometimes may result in complications. We created the NICHE (noninvasive cardiac hemodynamic evaluation) study to determine a procedure that could accurately predict right heart pressures without the invasiveness of catheterization, and therefore, without the complications. We decided to take ultrasounds of the right internal jugular (IJ) vein and predict the right atrial (RA) pressure from the vein's respiratory variation. We kept the tests identical for each patient, laying each one in a supine position, assessing the IJ vein at a 45 degree angle, and placing the ultrasound probe at the base of the sternocleidomastoid triangle. RHC through the IJ vein was performed immediately afterwards for each patient to compare the actual pressures to the predicted pressures. After collecting data from forty patients and comparing all the predicted pressures to the actual ones, we found that the ultrasound assessment of RA and right ventricular end-diastolic (RVEDP) pressures correlate with the RHC measurement of the same pressures. We plan to continue this study in a clinical setting to see how our method compares with RHC there.

O13**A Retrospective Analysis of Twenty Years Experience with Necrotizing Enterocolitis in a Neonatal Intensive Care Unit****Presenter(s)**

Hannah Reiser, Illinois Mathematics and Science Academy

Sarah Trevor, Illinois Mathematics and Science Academy

Advisor(s)

Jonathon Muraskas, Loyola University Medical Center

Necrotizing enterocolitis (NEC) is the most common life threatening acquired gastrointestinal (GI) disease in preterm newborns and can be mild to severe. Over 90 percent of NEC occurs in preterm newborns that have been fed at one to four weeks of age. Of those, the mortality can approach 50 percent in the most fulminate forms of NEC. Despite extensive research, the etiology of NEC in newborns remains unknown. Using a computer database, we identified 324 infants that had been patients of the Neonatal Intensive Care Unit with NEC, and obtained medical records of the patients for the past twenty years. We recorded data regarding birth weight, birth date and/or death date, gestational age, apgar scores, blood type, mother's blood type, and date of NEC onset. After data collection completion, we conducted queries to find trends between the patients with NEC, both those who survived and expired. Our queries examined the infant's sex, apgars, birth date, birth weight, gestation age, blood type, mother's blood type, and deaths. We are currently in the process of data analysis to determine the trends between the patients with NEC, both those who survived and expired. Our preliminary results show male dominance and A blood type in the lethal form of NEC. Our final results are currently pending.

O14**Affects of Antenatal Corticosteroids, Betamethasone and Dexamethasone, on the Occurrence of Intraventricular Hemorrhaging (IVH)****Presenter(s)**

Sarah Rokosh, Illinois Mathematics and Science Academy

Advisor(s)

Maliha Shareef, Loyola University Medical Center

Intraventricular hemorrhaging (IVH), most common within the first five postnatal days of premature infants weighing less than 1500 grams at birth, is bleeding of the brain inside or around one or more of the four cerebral ventricles, which produce the spinal fluid. No study, focused entirely on IVH and antenatal steroids has yet to be performed. I conducted a retrospective study over the past ten years (1996-2006) to evaluate the affect of antenatal steroids on intraventricular bleeds in preterm infants and their outcome as predicted by discharge from NICU or demise in NICU. From these infants' charts, I recorded infant birth statistics as well as mother steroid doses. Now that all data has been collected, data analysis is underway. From this analysis, I plan to determine whether reduction of doses of corticosteroids results in an increased occurrence of IVH. I would also like to determine which antenatal steroid, betamethasone or dexamethasone, proves to be more beneficial in reducing the occurrence of IVH in repeat regimens of corticosteroids. It is intended that these results will inform the medical community of the most effective dosage of antenatal corticosteroids to be administered to the mother.

O15**Differences in Allele Distributions of the Glu298Asp and T-786C Single Nucleotide Polymorphisms in the eNOS Gene in Patients with Atherosclerotic Carotid Disease (CD) Versus a Healthy Control Population****Presenter(s)**

Vincent Rossi, Illinois Mathematics and Science Academy

Advisor(s)

Vera Shively, Northwestern University Feinberg School of Medicine

Endothelial nitric oxide synthase (eNOS) is an enzyme that produces nitric oxide, a vasodilator, in the endothelial cells which line the walls of all vessels. The eNOS gene may play a role in the pathogenesis of vascular diseases, including atherosclerotic carotid disease (CD). Two single nucleotide polymorphisms (SNP) in the eNOS gene were examined, Glu298Asp and T-786C. Both of these are considered functional polymorphisms, meaning the different forms have been shown to impact the availability of eNOS to cells. The two polymorphisms were examined in DNA for thirty-one patients. Genotyping was done using polymerase chain reaction, restriction endonuclease digestion, and gel electrophoresis. T-786C results showed T/C genotype present in 55% patients versus 39% controls, and T/T in 26% patients versus 47% controls. C/C was present in 19% patients and 14% controls. Glu298Asp data demonstrated G/T present in 87% patients versus 94% controls, and T/T in 13% patients and 6% controls. G/G was not found in either group. Glu298Asp genotyping results were comparable between the two groups. However, in the T-786C, the presence of at least one copy of the rare C allele, (T/C or C/C), occurred more often in the CD patients; 74% versus 53% in controls. Although our sample size is small, this is an interesting trend. Genetic association studies have important implications in the future of personalized medicine, such as diagnosing and treating CD patients.

O16**Determining the Effect of PEDF and 34-mer on NF- κ B Dependent Regulation of Prostate Cancer Cells****Presenter(s)**

Sarah Shareef, Illinois Mathematics and Science Academy

Advisor(s)

Olga Volpert, Northwestern University Feinberg School of Medicine

Pigment epithelium-derived factor (PEDF) is a multifunctional protein with neurotrophic and anti-angiogenic activities that can be exploited for tumor therapies. Its functional activity is linked to two distinct fragments: the anti-angiogenic, 34-mer, and the neurotrophic 44-mer. We sought to determine the effect of PEDF active peptides on prostate cancer cells and to determine the role of NF- κ B in these effects. The prostate cancer cell line PC3 was treated with PEDF and synthetic 34-mer and 44-mer peptides, with or without the NF- κ B inhibitor, BMS-345541 for five days. Treatment with the 34-mer showed decreased cell numbers and condensed morphology suggestive of apoptosis. When BMS was combined with the 34-mer, we observed a similar decrease in cell number, but also a striking increase in multi-nucleated cells, suggestive of cell cycle arrest. This hypothesis was supported by Western blot demonstrating a two-fold increase of the cyclin-dependent kinase inhibitor, p21, in the presence of BMS. Our data suggests that in PC3 cells, the 34-mer PEDF fragment may induce cell cycle arrest followed by NF- κ B dependent apoptosis: therefore, the NF- κ B blockade results in cell cycle arrest. Further studies will elucidate the mechanism of cell cycle arrest by the 34-mer and may lead to PEDF-derived direct anti-tumor agents.

O17**Myxomatous Mitral Valve Repair: Development of an Algorithm to Quantify Mitral Leaflet Reduction for a Successful Repair****Presenter(s)**

Hyun Soo Sheen, Illinois Mathematics and Science Academy

Advisor(s)

Anna Huskin, Bluhm Cardiovascular Institute Northwestern University

Richard Lee, Bluhm Cardiovascular Institute Northwestern University

Myxomatous mitral valve prolapse (MVP) is an important cause of mitral regurgitation (MR) and congestive heart failure. Previous studies have shown that optimal surgical intervention for MVP is valve repair. However, due to the complex nature of repairing the mitral valve, many MVP cases are instead addressed by a valve replacement. The objective of the study was to identify the characteristics of repair that yielded success, (no recurring MR). The first part of the study focused on relating postoperative residual pressure gradient through the mitral valve (mm Hg) to reduction in mitral valve surface area (per cent) and also to postoperative mitral valve surface area (mm²). Results suggested that as the mitral valve surface area reduction increased, postoperative gradient decreased. Data further suggested that an increase in postoperative mitral valve surface area resulted in a reduction of postoperative gradient. Based on the results of this analysis it is possible to conclude that when the surface area of the mitral valve repair is over-reduced, an increase in postoperative gradient is evident. This increased gradient often results in complications such as mitral stenosis. Further analysis such as correlating the amount of mitral valve dissected and overlap to degree of post operative MR are in progress.

O18**Effects of Obesity and Race on Diabetes Mellitus Type 2****Presenter(s)**

Jisun Yoo, Illinois Mathematics and Science Academy

Advisor(s)

Sowmya Anjur, Illinois Mathematics and Science Academy

This review of literature targeted the effects of obesity and race on diabetes mellitus type II. It is evident that minority races (such as Hispanics and African-Americans) are extremely susceptible to this disease. A possible reason behind this is that the majority of these people live in a lower socioeconomic group. Their lack of resources can cause stress, and also inhibits their access to proper medical care which worsens their diabetes; emotions associated with stress, such as fear and shock, have also been considered to trigger diabetes. Apart from minority groups, a significant number of Asian countries' obesity and diabetic rates are also skyrocketing, especially in city areas such as Hong Kong. This could be associated to the spread of Western culture, like America's love for fast food. It is clear from this study that all cultures must improve their dietary habits to decrease the prevalence of diabetes.

O19**Particulate Matter Causes Endothelial Cell Barrier Disruption and Induces Acute Lung Damage in a Murine Model of Asthma: Physiological and Genomic Contributions****Presenter(s)**

Eva Yuan, Illinois Mathematics and Science Academy

Advisor(s)

Joe Garcia, University of Chicago

Liliana Moreno, University of Chicago

Ting Wang, University of Chicago

Epidemiologic studies have confirmed statistical correlations between rising cardiopulmonary morbidity/mortality and short-term exposure to ambient particulate matter (PM). However, the mechanisms that lead to the aggravation of these cardiopulmonary conditions are not well elucidated. We investigated the effects of PM on human endothelium barrier function and murine models of asthma. We measured changes in the transendothelial monolayer electrical resistance (TER, a highly sensitive measure of barrier function) of human pulmonary artery endothelial cells (HPAECs). We analyzed bronchoalveolar lavage (BAL), lung histology, and gene expression changes with microarray techniques on a murine model of asthma introduced by ovalbumin post intratracheal PM treatment. Exposure of HPAECs to PM-induced endothelial cell barrier disruption was administered in a dose (10-100 $\mu\text{g/ml}$)- and time (0-10 hrs)-dependent fashion, as determined by TER. PM exposure evoked eosinophil and neutrophil infiltration into airways, elevated BAL protein content, and stimulated secretion of TH2 cytokines into murine airways. PM consistently induced expression of genes in innate immune responses, chemotaxis, and complement system pathways, potentially contributing to asthmatic susceptibility and severity. All of the data are consistent with growing epidemiologic results and indicate that a PM-specific pro-inflammatory and allergic molecular signature serves to exacerbate asthmatic conditions.

P01**Gamma Band Frequency Analysis for Language Localization in the Brain****Presenter(s)**

Audrey Auyeung, Illinois Mathematics and Science Academy

Anjulie Gang, Illinois Mathematics and Science Academy

Anil Vaitla, Illinois Mathematics and Science Academy

Advisor(s)

Vernon Leo Towle, University of Chicago

Electrocorticographic (ECoG) recordings of neural impulses are the accepted gold standard to seizure detection. However, with the requirement of subdural electrode grid implants in patients, this method is unfavorable due to its invasiveness. The study's purpose was to determine whether areas of the brain related to expressive and receptive speech can be identified through ECoG recordings during various spontaneous activities. Patients with severe epileptic seizures were used in this study because their hospitalization required the implantation of subdural electrode grids. These implanted electrodes monitored patients' brain activity. The patients were recorded on camera to identify them engaging in activities, including receptive speech, eating, and playing board games. Clips from periods where the patients were awake but resting served as controls. Data were processed and converted into average power spectrums using the Neuroscan EDIT module. A correlation analysis was performed on the gamma band analysis data to determine regions of the brain functional in language. Analysis of the data collected from multiple sources shows a concentration of gamma frequency band activity from 40 to 120 Hz in various regions of the brain, with particular activation in the left and right parietal lobe during conversations. As proposed here, gamma band analysis may lead to the next generation of functional brain localization techniques.

P02**Alzheimer's: Comparison of Neuronal Proteins****Presenter(s)**

Perry Bradford, Illinois Mathematics and Science Academy

Advisor(s)

Susan Styer, Illinois Mathematics and Science Academy

Millions of people are affected by Alzheimer's disease (AD) and their chances of expressing this disease increase with age. AD is a progressive degenerative disease and an incurable condition that destroys brain cells. In this investigation ntera2 embryonal cells were treated with retinoic acid (RA) to differentiate them into neuronal cells to determine if there is a difference in structure. The cells were examined microscopically and a physical difference was found between ntera2 cells with and without RA. The ntera2 cells without RA were found to be circular and defined, while the cells treated with RA were rigid and ovalular. The cells were also examined through Western blotting for the neuronal protein β -tubulin. β -tubulin is a microtubule (MT) element expressed in neurons and identifies specific neurons in nerve tissue. Proteins, such as β -tubulin, had a lower expression in patients with AD. β -tubulin was present in both ntera2 cells treated with and without RA. This indicates that the blot was successful in detecting the protein. The model developed in this study may be used to find preventative measures against AD because it examines the expression of proteins that are altered in AD.

P03**Effects of Meditation on Sleep and Stress on Patients with Chronic Insomnia****Presenter(s)**

Mamatha Challa, Illinois Mathematics and Science Academy

Advisor(s)

Ramadevi Gourineni, Northwestern University

Chronic insomnia is defined as difficulty falling or staying asleep, associated with daytime dysfunction. Primary insomnia is when there are no medical or psychiatric conditions causing this difficulty. Primary insomnia is associated with a state of 24-hour hyperarousal and increased levels of stress. Patients with primary insomnia have elevated levels of cortisol, a stress related hormone. Many studies have shown that meditation (a state of focused internalized attention resulting in a state of relaxation) reduce measures of arousal and stress. Dr. Ramadevi Gourineni is conducting a study to see if meditation will reduce arousal and stress and improve sleep in patients with primary insomnia. My involvement in this project consists of analyzing sleep and cortisol measures in patients with insomnia. Both sleep and cortisol measures were collected before and after intervention with meditation. Sleep measures were analyzed from sleep logs and cortisol levels from saliva samples collected from the patients. Our results showed a trend towards a greater reduction in the cortisol levels and higher improvement in sleep measures in insomnia subjects who meditated compared to the ones who did not. These results suggest that there is a correlation between stress and sleep in patients with primary insomnia. In addition, meditation may be a new and innovative way to reduce stress and improve sleep in insomniacs.

P04**Stroke Therapy at University of Illinois at Chicago****Presenter(s)**

Hannah Dada, Illinois Mathematics and Science Academy

Velin Tchakalov, Illinois Mathematics and Science Academy

Advisor(s)

Konstantin Slavin, University of Illinois at Chicago

Developed by the Northstar Corporation, a new treatment has arisen to assist in rehabilitation after stroke. Termed the Northstar Everest project, in this treatment doctors implant a small metal device into the chest of the patient, and link electrodes from it to the brain. These stimulate the cerebral cortex and provide faster treatment in the regaining of motor function in either the left or right upper hemisphere. Our task was to examine the patient records of eight people who underwent this treatment at UIC, and compile a list of complications as well as benefits of the treatment. Our investigation found that patients aged sixty and older tended to have complications including infection and headaches. Some older patients did not show improvement with motor function after treatment. However, patients aged between twenty and thirty recovered much faster, without complications after surgery, and showed an improvement of motor function. One patient even improved by 50% over the course of the treatment. We would need a larger pool in order to make accurate conclusions, but based on our preliminary results, patients between the ages of twenty and thirty responded better to the treatment.

P05**Development of an α -Mannosidase 2A2 Based Gene Therapy for Glioblastoma Multiforme****Presenter(s)**

Andrew Gentile, Illinois Mathematics and Science Academy
Monica Kao, Illinois Mathematics and Science Academy

Advisor(s)

Roger Kroes, Falk Center for Molecular Therapeutics

Glioblastoma multiforme (GBM) are highly invasive gliomas and are among the most deadly type of primary brain tumor. Previous studies have shown that the induced expression of certain genes synthesizes key oligosaccharide structures located on the outer cell membrane of glioblastomas. These structures are thought to be critical in glioma invasivity and in the proliferation of cancer cells. This year, we worked to develop laboratory techniques and performed tests on human brain tumor cell lines that were transfected with a mammalian expression plasmid containing the α -mannosidase 2A2 (MAN2A2) gene. Our goal is to analyze the phenotypic effects of MAN2A2 overexpression in the U373MG human glioma cell line. After identifying thirty stable MAN2A2 transfectant cell lines, we examined the four highest expressers by qRT-PCR analyses and demonstrated that these transfectants produced from 13- to 23-fold more MAN2A2 mRNA than control U373MG cells. These clones demonstrated decreased cellular proliferation relative to the parental cell lines. To simulate MAN2A2-associated alterations in adhesion and invasivity, we used *in vitro* assays and demonstrated both modifications in adhesivity to select substrates and decreased invasion through a simulated brain matrix. Thus far, our results provide strong *in vitro* evidence for the future creation of a novel adenoviral vector designed to overexpress the MAN2A2 gene that may have potential to provide an effective gene based therapy for GBM.

P06**Sequencing of the Citron Kinase Gene in Patients with Microcephaly****Presenter(s)**

Nina Gnedin, Illinois Mathematics and Science Academy

Advisor(s)

William Dobyns, University of Chicago

Microcephaly (MIC) is a common developmental disorder in which the head and brain are significantly smaller than normal. Severe forms of MIC are often genetic. Citron kinase (CIT) is a gene that is known to cause reduced brain and head size in mice and rats. We chose to optimize and sequence exons 3-10 and 32-35, which encode two key domains in 72 patients with MIC. We have optimized eight out of the eleven required primer pairs. We have amplified two exons. We are still in the process of purifying them for sequencing. Once the exons have been purified and sequenced, we will analyze the data for mutations.

P07**Anosognosia and Alzheimer's Disease****Presenter(s)**

Vidya Govind-Thomas, Illinois Mathematics and Science Academy
Anne Pipathsouk, Illinois Mathematics and Science Academy

Advisor(s)

Eric Larson, University of Chicago

Insight is the ability to self reflect and to be self-aware. Therefore, the loss of insight is the inability to recognize deficits within oneself. Poor insight is often an early characteristic of Alzheimer's Disease (AD). In this study we evaluated two hypotheses concerning insight in AD by administering three Stroop tests, the Anosognosia Questionnaire-Dementia, and the mod-6 test to fifty patients. Our first hypothesis stated that patients have better insight than they can express, and that part of their lack of recognition of symptoms of cognitive dysfunction is due to denial of their difficulties, perhaps to prevent depression. We used explicit and implicit measures of insight, but found no support for this hypothesis. Our second hypothesis stated that patients with poor insight have better mental health than patients with good insight. We confirmed that patients have fewer symptoms of poor mental health than patients with accurate insight. Significant negative correlations were found between patient distress and loneliness scores and anosognosia scores ($p = .024$), suggesting that as a patient loses insight they reported less loneliness and distress. Our findings add to the overall knowledge regarding loss of insight in Alzheimer's disease patients.

P08**Moderate Ethanol Preconditioning of U373 Cells and Its Effects on Ethanol****Presenter(s)**

Tyce Herrman, Illinois Mathematics and Science Academy
Ellen Ryan, Illinois Mathematics and Science Academy

Advisor(s)

Michael Collins, Loyola University Medical Center
Donald Dosch, Illinois Mathematics and Science Academy

Stress preconditioning has been shown to significantly decrease necrosis of cardiac and brain tissue. Specifically, the introduction of moderate ethanol preconditioning (MEP) has been shown to increase cell vitality in brain tissue cultures. The Collins laboratory has found that the transducer protein protein kinase C (PKC) is significantly increased after four and six days of conditioning and may cause the upregulation of anti-degradation protein heat shock protein 70 (HSP70). HSP70 has been shown to increase significantly with MEP treatments. The PKCs have several kinase activities including regulation of cell growth, differentiation, hormone secretion, and important for this project, membrane functions. Our experiment is designed to test levels of two PKC isoforms, alpha and epsilon, with and without MEP. In order to perform the experiment, we grew six cultures of U373 glial cells in ethanol for 6 days, sampling at days 2, 4, and 6. A Western blot analysis was then performed on the cultures to determine the levels of PKC. At this time, we are working to establish the optimal environment for Western blotting.

P09**Synaptic Targeting of Amyloid Beta Oligomers for Basis of Memory Loss and Alzheimer's Disease****Presenter(s)**

Kevin Lam, Illinois Mathematics and Science Academy

Advisor(s)

William Klein, Northwestern University

Accumulated A β -derived diffusible ligands in individuals with Alzheimer's disease have a detrimental effect on synapse function, composition, and morphology; however, the mechanisms leading to synaptotoxicity are not completely understood. This project is aimed towards identifying a defense against Alzheimer's disease by analyzing the correlation between the presence of insulin and drebrin density as an indicator of spine and synaptic health. Using Metamorph, a morphometric software, I analyzed images obtained from mature hippocampal cells treated with a neurotoxin and different compounds. I measured the number of immunolabeled puncta, which represent the number of spine (compartment of the synapse) along a defined length of dendrite. Measurements were taken with a series of images captured in three different treatment groups [VEHICLE, ADDLs (neurotoxin), and ADDLs with insulin]. Results of this study have shown that the number of puncta per length of dendrite was close to VEHICLE control values, while the ADDL treatment induced a loss of spines suggesting that insulin prevents the ADDL synaptotoxicity. The impact of soluble A β oligomers on synaptic composition and morphology has revealed that ADDLs cause a significant decrease in dendritic spine density. This observed deterioration of dendritic spines links ADDLs to a major component of Alzheimer's disease and strongly supports the belief that ADDLs in Alzheimer's disease brains cause cognitive damage and lead to dementia.

P10**Epigenetic Mechanisms To Rescue Neural Tube Defects Caused By Mutated Pax3****Presenter(s)**

Ernestina Perez, Illinois Mathematics and Science Academy

Robert Till, Illinois Mathematics and Science Academy

Advisor(s)

C. Shekhar Mayanil, Children's Memorial Research Center

Pax3 is expressed early during embryonic development in spatially restricted domains including limb muscle, neural crest, and neural tube. Research has shown that mutation of the Pax3 gene can cause problems with stem cell migration in the embryonic neural tube in mice, thus resulting in neural tube defects. It is hypothesized that these neural tube defects caused by mutation in Pax3 can be rescued by epigenetic mechanisms. Our lab has identified several novel folic acid responsive targets that remodel chromatin and provide epigenetic mechanisms for rescue of neural tube defects. By breeding Pax3 heterozygous mice, and giving folic acid supplements to female mice prior to pregnancy, we were able to rescue the neural tube defect phenotype in Pax3 mutant homozygous embryos, which not only showed no neural tube defects, but also lived to full term and beyond. Using these folic acid responsive targets, as clues for therapeutic targeting, we believe that prenatal rescue of neural tube defects would be possible in the near future.

P11**An Immunocytochemical Investigation of Inhibitory Interneurons in the Ventral Tegmental Area (VTA) and Substantia Nigra (SN) of the Rat Brain****Presenter(s)**

Sophia Pilipchuk, Illinois Mathematics and Science Academy

Advisor(s)

Louis Lucas, Loyola University

Chronic stress has been shown to impair dopamine production in the brain. Presently, there is a lack of understanding of changes in the molecular pathway, which initiate dysfunction of dopaminergic synthesis. We hypothesize that midbrain inhibitory interneurons are responsible in suppression of dopamine activity originating in the midbrain. The present study investigates expression of GAD-65 and GAD-67, enzymes required for synthesis of gamma aminobutyric acid (GABA) presynaptic enzymes responsible for induced inhibition of dopamine release. We also test for colocalization of GAD 65/67 with delta-opioid (DOR) and mu opioid receptors (MOR), which would suggest presence of interneurons. Rat brain tissue from chronic restraint stress experiments with recovery were used for immunocytochemical analysis, followed by cell counts of colocalized neurons using confocal microscopy. Results indicate GAD-67 and DOR are expressed in both VTA and substantia nigra (SN), with greater expression of DOR (34 GAD-67 positive and 40 DOR positive neurons counted in SN). Colocalized immunoreactivity was greater in VTA (47 GAD-67 positive and 51 DOR positive neurons). Colocalization results from the same cell count show 32 GAD67/DOR colocalized neurons in the SN and 42 neurons in VTA. In conclusion, present results suggest that opioid GABA-ergic interneuronal mechanisms are involved in dopamine synthesis inhibition.

P12**Alzheimer's Disease Etiology: A Literature Review of Genetic, Environmental and Physiological Factors****Presenter(s)**

Jonathon Schwarzbauer, Illinois Mathematics and Science Academy

Advisor(s)

Susan Styer, Illinois Mathematics and Science Academy

As longevity increases in the twenty-first century, Alzheimer's disease (AD) is becoming a major health problem, since nearly a third of all people who live to old age will develop the disease. Although the defining characteristics of the disease are the buildup of amyloid plaques in the brain and neurofibrillary tangles within cells, the disease contains a constellation of cellular changes, so exactly which one leads to cell death is unknown. Through a literature review of scientific articles and books, I will construct an overview of the research community's current understanding of the etiology (both genetic and environmental) of Alzheimer's disease. As researchers have yet to fully understand the effects of individual physiological changes, I summarize the many differing hypotheses, such as the leading theory of β -amyloid cascade hypothesis, which claims the breakdown of APP into amyloid plaques triggers a cascade of effects, which eventually lead to cell death. I will detail the known risk factors, including specific genotypes, heart disease, low education, and proposed environmental toxins. As knowledge of the causes and risk factors of AD can lead to methods of preventing it, a few of the more well founded methods will be described, such as maintaining mental stimulation.

P13**The Effects of Classical and Pop Music on the Memory of IMSA Students****Presenter(s)**

Katherine Tu, Illinois Mathematics and Science Academy

Advisor(s)

James Priovolos, Illinois Mathematics and Science Academy

The practice of students listening to music while doing homework has become quite common in recent years. From past studies, it has been found that music has a positive effect on memory. The question of what genres of music help memory, though, has yet to be answered. This study seeks to determine the effects classical music and pop music have on the memory of IMSA students already engaged in music classes such as band, orchestra, and choir. The study involved having students play a twenty card memory game in each trial of this four trial experiment. The first and third trials had students listening to either classical or pop music with the remaining two trials placed chronologically in between having no music at all. After testing fifty students, it was found that pop music and classical music, in comparison to no music, have a negative effect on the memory of IMSA students, with an 11.3% and 9.6% increase respectively. Between classical and pop music, it was found that pop music had a more negative effect on the memory of IMSA students, with a 4% increase in time over the classical trial.

P14**Neurobiology of Category Learning****Presenter(s)**

Milan Udawatta, Illinois Mathematics and Science Academy

Advisor(s)

Deborah Little, University of Illinois at Chicago

How do you differentiate between a poisonous and nonpoisonous snake? The purpose of our research is to identify the brain networks that are used during category learning. Category learning is defined as the process of learning how to assign objects to separate categories. Two mechanisms have been developed to describe category learning: 1) the responding neuronal network becomes stronger and more efficient as people learn, and 2) as learning progresses, the brain will select the best network from a wide array of neuronal networks. To examine this question, we created four random prototype patterns of dots. These consisted of seven white dots on a black background, framed inside a box. Each category was distorted thirty times by moving each dot pattern by a set number of cells. Eight healthy subjects were trained to classify dot patterns into four categories. Response accuracy and latency were recorded. fMRI data was collected before and after training. Comparisons were conducted between the matching task and fixation for novel, trained, and untrained tests for both pre and post practice. Analysis of the first subject's data shows that there was an increase in activity with training in brain regions involved in attention and visual spatial processing, providing support for the second mechanism.

Q01**A Measurement of Dijet Azimuthal Decorrelation at Forward Rapidities****Presenter(s)**

Stephanie Brandt, Illinois Mathematics and Science Academy

Advisor(s)

Don Lincoln, Fermi National Accelerator Laboratory

The DO detector at Fermilab measures jets of particles that are produced by a proton-antiproton collision in Fermilab's Tevatron. The theory describing these sorts of collisions, quantum chromodynamics (QCD), approximates data well for jets emitted at a polar angle near 90° ; but jets that are emitted closer to the beam will require more careful approximation. This analysis compared data taken by the DO experiment to approximate QCD, over a span of transverse momenta and angles. This involved sorting and applying cuts to data as well as creating histograms so that distributions of momenta and angles could be studied visually. QCD is shown to agree well with data. A visual comparison of the distribution of the azimuthal angle between the two jets ($\Delta\phi$) shows that there is very little difference between the QCD approximations and real data. A continuing study will remove residual distortions made by the detector and provide a detector-independent measurement.

Q02**Analysis of Contained Muon Events in the MINOS Far Detector****Presenter(s)**

Matthew Castillon, Illinois Mathematics and Science Academy

Travis Mui, Illinois Mathematics and Science Academy

Advisor(s)

Maury Goodman, Argonne National Laboratory

The MINOS experiment looks for neutrino oscillation events, the process of a neutrino changing flavors, by sending a stream of muon neutrinos from Fermilab's Main Injector to the Far Detector at the Soudan Mine in Minnesota. At the Far Detector, neutrinos interact with the scintillator strips, and the tracks of the muon and other particles are recorded. When a muon neutrino interacts, it either becomes a muon neutrino, a tau neutrino, or an electron neutrino. In each case, a neutral or charged interaction can occur, where neutral interactions produce a neutrino and charged interactions produce a lepton and a neutrino. Our research investigates these events by categorizing them based upon computer-generated images of the events, looking for specific types of events that indicate a muon trail. We have scanned approximately 450 events and expect to finish about 800 events. Since we know that there is a set amount of neutral interactions, the number of contained muon events and rock muon events help us determine the amount and frequency of neutrino oscillation events. The final result of our work, along with other previous research, will be used to more accurately measure θ_{23} and further our knowledge of neutrino oscillation and its properties.

Q03

Future Possibilities for Experiments to Measure θ_{13}

Presenter(s)

Tiernan Evans, Illinois Mathematics and Science Academy

Advisor(s)

Maury Goodman, Argonne National Laboratory

During my investigation, I looked into the different types of neutrino experiments and the various advantages and disadvantages of each. Currently, there are two types of experiments: reactor experiments and accelerator experiments. This year, I compared the different experiments to measure θ_{13} , the main goal of most future neutrino experiments. Daya Bay and Double Chooz are reactor experiments, while MINOS, NOvA, and T2K are accelerator experiments. Currently, MINOS is running, while Daya Bay, T2K, and Double Chooz are under construction. NOvA has been funded, but funding has been cut for FY08, which will delay the start. While MINOS is on-axis, both NOvA, and T2K are off-axis. There are also several possible reactor experiments in the more distant future: Angra, and Reno, and later Triple Chooz. Other types of distant future experiments include ν Factory, Beta Beam, and Superbeam. While accelerator experiments can limit θ_{13} better than reactor experiments, the detectors needed are much larger. Because of the increased size, accelerator experiments are much more expensive than reactor experiments. A direct comparison of the ideas for future neutrino experiments can help the physics community decide which experiments are worth further investment.

Q04

Electron Beam Trajectory Optimization in a Fermilab Particle Accelerator

Presenter(s)

Forrest Iandola, Illinois Mathematics and Science Academy
Sandeep Paruchuri, Illinois Mathematics and Science Academy

Advisor(s)

Raymond Fliller III, Fermi National Accelerator Laboratory
Michael Syphers, Fermi National Accelerator Laboratory

In the near future, the International Linear Collider (ILC), a new 250 GeV electron accelerator, may be constructed. One step in designing the ILC is to use a small linear accelerator, or LINAC, to expand the body of knowledge on LINAC hardware and software. Prior to this project, centering the electron beam in the A0 Photo Injector, a LINAC used for ILC research and development, required a tedious process of reading beam position monitors (BPMs) and manually tuning of dipole corrector magnets to steer the beam. In order to automate the process of centering the beam, a C code has been developed to read the BPMs and to determine appropriate adjustments for the corrector magnets. This code allows one to study various algorithms to adjust corrector magnets to center the electron beam. The code successfully reads the BPMs and generates corrector magnet settings. The final step will be to run the code at a time when the Photo Injector is developing an electron beam in order to verify that the code is capable of centering the beam and recording its calculations to the A0 control system.

Q05**Searching for a Low Mass Higgs Boson with Light Using Fermilab Collider Data****Presenter(s)**

Benjamin Ray, Illinois Mathematics and Science Academy

Advisor(s)

Robert Craig Group, Fermi National Accelerator Laboratory

Mike Lindgren, Fermi National Accelerator Laboratory

High energy photon data from the CDF experiment at Fermilab was studied to search for the Higgs boson, a theoretical particle that has not been observed experimentally. It is hypothesized that a Higgs boson that doesn't couple to fermions (fermiophobic) could be created by proton-antiproton collisions at the Tevatron. Computer programs (C, LaTeX, and ROOT) were used to analyze detector data and compare it with Monte Carlo simulations. Code was developed to incorporate the latest Tevatron data and to calculate the efficiency (including time dependence) of the analysis program and the detector in recognizing radiation from Higgs decay. As a result of this work, a scaling factor relating detector output to simulation has been developed which is applicable to high energy electron or photon events incorporating the new CDF data. In addition, a hypothetical Higgs signal peak on top of background events has been generated. With these tools in place, the search for evidence of a Higgs boson may proceed. Currently, work has begun on computer programs that would set an upper limit on the mass of the fermiophobic Higgs boson, subject to the sensitivity of this data.

Q06**Symmetry In Physics****Presenter(s)**

Francis Walsh, Illinois Mathematics and Science Academy

Advisor(s)

Gabriel Kerr, Northwestern University

The concept of symmetry now plays a central role in much of modern theoretical physics. In addition to vastly simplifying some problems, examining a system through the lens of symmetry also offers new insight into fundamental laws of reality. My investigation began by reviewing the mathematics necessary to express symmetry in physical systems, such as the classical groups and vector spaces. The classical groups consist of the special and general linear, orthogonal, and unitary groups, and the object of our attention was their representations as groups of linear transformations on a vector space. These representations preserved some quantity on the vector space acted upon. Having the necessary tools to describe symmetry, the investigation then introduced some basic quantum mechanics. We then combined this knowledge to understand some of the symmetry of modern theoretical physics, particularly the strong nuclear force. One such example is the "eightfold way," which helps to describe the quark model and the arrangement of baryons and mesons into octets. From this vantage point, we then proceeded to examine the standard model of particle physics in some detail and gained insight into the powerful and central role mathematical symmetry plays in describing nature.

R01**An Examination of Treatment Impact on Cognitive Functioning in Children with Opsoclonus Myoclonus Syndrome (OMS)****Presenter(s)**

Kevin Crews, Illinois Mathematics and Science Academy

Advisor(s)

Scott Hunter, University of Chicago

Opsoclonus myoclonus syndrome (OMS) is a rare disorder that affects the brain, resulting in trouble with attention, language, mood, behavior, and motor skills. By examining the relationship between the medical treatment of OMS and patients' performance on standard neuropsychology tests, speculations can be made about the effects of treatment and the causes of the disease that can guide expectations about prognosis and remediation. With the current study, neuropsychological and treatment data from all patients with OMS who had been tested multiple times revealed the relationship between performance and treatment over time. Results indicated that children consistently performed better while on immunosuppressant and steroid treatments than they did while on others. Specific tests revealed strong positive correlations between treatment and the patients' verbal, language, attention, memory, and sensory skills. The analysis of this data supported the autoimmunity theory of OMS in that children typically performed better while on immunosuppressants than they did off of the drugs.

R02**Liar, Liar Pants on Fire****Presenter(s)**

Crystal Croyl, Illinois Mathematics and Science Academy

Kenneth Higa, Illinois Mathematics and Science Academy

Sarah Lightfoot Vidal, Illinois Mathematics and Science Academy

Advisor(s)

David Evenson, Illinois Mathematics and Science Academy

When detecting a truth from a lie, the average person has a 53% chance of being correct. However, FBI agents are the only people who have proven to have a slightly better chance at detecting a lie than others. Some law enforcement members are trained in ways to better tell if one is lying or not in order to help solve crimes. The number one myth of how to detect a liar is by watching to see if they avert their eyes. This idea is closely followed by the idea that liars shift around more and have a higher tendency to touch their noses. However, all of these are common misconceptions. Several studies have shown that liars are actually more likely to strain their voice, move around less, blink less, or have what are known as micro-expressions. In our experiment, we recorded participants telling both a truth and a lie to two questions. We tested these studies' findings by seeing if we could better detect these lies with this new information. This study allows us to better understand the science behind lying and could help many members of law enforcement.

R03**Handedness and Mathematical Ability at IMSA****Presenter(s)**

Hilary Dietz, Illinois Mathematics and Science Academy

Advisor(s)

Susan Styer, Illinois Mathematics and Science Academy

This investigation was performed to explore the trend that left handed students have a better chance of being mathematically precocious. I wanted to determine whether or not this trend held true at IMSA, or if the filtered environment affected the results. A survey that asked questions regarding handedness and mathematical ability was administered to a sample population of 232 students at the Illinois Mathematics and Science Academy. The students were asked to give their SAT math score, graduation year, and which hand they prefer for each of ten everyday tasks. The frequencies of left handed students and right handed students were compared to predetermined ratios for the general population and the population of mathematically precocious youth using the chi square goodness-of-fit analysis. The results suggest that the student body does not follow the trends of handedness for the general population, but rather is closer to that of the mathematically precocious youth. This investigation, and others that inspired it suggest that whenever the sample population is mathematically precocious the ratio between left handed students and right handed students decreases. From this, one could conclude that left handed students have an increased chance of being mathematically gifted. However, further investigation is necessary.

R04**Physiological Responses and Coping Mechanisms to Stress Among High School Students****Presenter(s)**

Chelsea Fu, Illinois Mathematics and Science Academy

Advisor(s)

David Evenson, Illinois Mathematics and Science Academy

Cumulative negative stress in adolescents is said to have an adverse effect on their body and mind over time. A previous inquiry focused on understanding the potential negative stresses at IMSA, their direct effect on the students, and the possible coping mechanisms used by the IMSA students to deal with the stressful situations. This investigation broadens the scope of the previous inquiry by collecting more data from the current IMSA students as well as extending the research into a typical public high school. The same questionnaire used to survey the IMSA students will be used to survey a local high school. The investigation will determine which aspects of the public school students' lives are the most stressful; what the physiological and mental effects of the stress are; and what coping mechanisms the public school students have found to be most useful. A comparison will be made between the IMSA and public school environments to determine if stresses in a boarding school with an advanced curriculum differ significantly from those identified by students in a normal public school setting. This investigation is currently under review for approval by a local public high school.

R05**Visualizing and Analyzing Eye Movement from Paintings****Presenter(s)**

Sarah Kang, Illinois Mathematics and Science Academy

Advisor(s)

Steven Franconeri, Northwestern University

When tracking the eyes of someone looking at a painting, one finds that the eyes are drawn towards areas of interest for longer periods of time, which implies that eye movements can be predetermined. However, we must first be able to visualize the spatial and temporal relationships between eye movements. By plotting either the fixation points or scanpaths directly on top of the painting, we have found that certain paintings have little to no areas of interest while other regions in different paintings were inspected by almost every subject. The use of two-dimensional dots enables us to see popular regions. Three-dimensional dots do the same while portraying the temporal relationship between successive fixation points. Two dimensional scanpaths, on the other hand, exhibits the path that the eyes of the subject took while three dimensional scanpaths illustrate both the path as well as the temporal relationship of the viewer's eyes. The use of two-dimensional visualizations has enabled us to clearly see the spatial relationship between each saccadic eye movement while the use of three-dimensional visualizations portrays the temporal and spatial relationships between saccadic eye movements.

R06**Understanding Rhesus Monkeys' Abilities to Think Outside Their Instinctual Contexts****Presenter(s)**

Tatiana Lakshmanan, Illinois Mathematics and Science Academy

Advisor(s)

Lee Cera, Loyola University

Richard Duff, Loyola University

Jawed Fareed, Loyola University Medical Center

Prior research showed that rhesus monkeys have limited ability to comprehend humans' and other monkeys' intentions due to their limited instincts and experience. These authors concluded that rhesus monkeys are more inclined to competition than cooperation, which is seen in most nonhuman primates. The current project was designed to determine rhesus monkeys' abilities to think outside their instinctual contexts, done by means of a human experimenter trying to get one of the monkeys to complete a set of desired tasks with a simple spatial puzzle. Treats and a training clicker were used to encourage the monkey's cooperation. An experimental monkey was chosen because she appeared to be the most willing to participate and the quickest to learn. After about six months of weekly 2.5-hour sessions, the monkey was able to pick up a piece and release it after getting a treat; however, she never purposefully replaced any piece in any hole. With more time, the monkey may be able to replace pieces in the puzzle, showing a fuller understanding of the experimenter's intentions. This experiment will help researchers to understand how rhesus monkeys think and to create activities that allow the monkeys to express their natural behaviors.

R07**The Effects of Parental Psychopathology on Child Temperament****Presenter(s)**

Henry Liang, Illinois Mathematics and Science Academy
Laura Thompson, Illinois Mathematics and Science Academy

Advisor(s)

C. Emily Durbin, Northwestern University

Dr. Emily Durbin is conducting a study of the effects of familial relationships and parental psychopathology on temperament traits in children between the ages of three to six. Children performed ten different tasks, each developed to elicit different emotions in order to measure differences among children in their temperamental reactivity. Each parent was interviewed to measure the presence of various psychological disorders in their lifetime. The lab visit was coded for children's emotional expressions to measure their proneness to experience happiness, sadness, anger, and fear. This particular study used these data to specifically examine the following question: How does parental substance abuse or anxiety disorders affect the emotions of their children in response to the laboratory tasks? Statistical analyses compared children whose parents had a substance or anxiety disorder during their life to children whose parents did not on laboratory measures of children's emotions. Results suggested that these two groups of children did differ significantly from one another. Specifically, children whose fathers had a history of alcohol dependency or drug abuse, or whose mother or father had a history of any anxiety disorder, showed more anger. Similarly, children whose mothers had a specific phobia or alcohol dependency, or whose fathers had a history of substance dependency, showed more fear.

R08**Do Women Really Cry More? A Study on Gender and Empathy****Presenter(s)**

Ranait O'Connor, Illinois Mathematics and Science Academy

Advisor(s)

Joan Y. Chiao, Northwestern University
Vani Mathur, Northwestern University

Empathy can be defined as a person's vicarious affective response. A common stereotype is that women are more empathic than men. However, psychologists have not confirmed this conclusion. Some researchers believe that empathy is directly affected by socialization, while others maintain that it is dependent upon genetics. We completed two experiments to examine gender effects on empathy. In the first, participants completed empathy measures. No significant difference was found between female and male scores, though these results were limited by small sample size and unequal groups. Given these results and those from Klein and Hodges, that suggested women are more empathically accurate than men only when aware they are being tested on empathy, we designed a second study to examine the effects of gender role. Forty participants will be primed with either the same or opposite gender. Empathy will then be measured through ratings in response to pictures of people in pain, the Empathy Quotient for state empathy, and the IRI for trait empathy, to determine the effect of gender-role priming on the participant's empathic state. Participants will also complete the BEM sex-role inventory as a measure of gender role orientation. We are currently collecting data for this second study.

R09**The Combined Effects of Altering Visual and Source Content of Aphorisms****Presenter(s)**

Seth Pree, Illinois Mathematics and Science Academy

Advisor(s)

David Rapp, Northwestern University

Studies have shown that the source of information and ease of perception of text (such as whether the message is easily read) influence a reader's willingness to believe the message and their ability to remember it. The current study intends to investigate these issues in a single project to test the combined effects of perceptibility and source credibility on readers' beliefs and memory for text information. Participants in this study will receive unfamiliar aphorisms, presented as statements credited to sources possessing varying reputations. In addition, each aphorism will be presented in either an easy to read or difficult to read color. Following the presentation of each aphorism, the participants will be asked to indicate how true each statement is, and after reading all of the aphorisms, will also be tested for their ability to recognize the source of each aphorism. To date, the study materials have been normed for credibility, and the experiment set up, but only preliminary results will be presented. These results include the norming data collected that were used to rate sources on their credibility. As this study is carried out, it will reveal the effects of combining variables that influence the accessibility of a statement.

R10**Determining How Ethanol in the Mother's Diet Affects Thyroid Status of the Fetus/Offspring****Presenter(s)**

Karen Song, Illinois Mathematics and Science Academy

Advisor(s)

Eva Redei, Northwestern University Feinberg School of Medicine

Laura Sittig, Northwestern University Feinberg School of Medicine

In this study we are going to be using the model of fetal alcohol-exposed rats, which represents moderate alcohol consumption during pregnancy for humans. Alcohol has the ability to have long-term psychiatric effects on the offspring because hormone production is decreased, which is used to assist in the development of the brain. We seek to analyze the changes in hormone production and enzymatic regulation of thyroid hormone between groups of rats. Comparing ethanol-exposed (via maternal diet) fetuses and controls (via normal maternal diet), the thyroid hormone T4 and the TH-regulating enzyme Dio3 will be quantified. RNA of the hypothalamus and placenta tissue samples has been isolated and purified. Those samples will later be compared within each of the different groups in a quantitative real time PCR (qPCR). It is important not to cross contaminate the samples because that could affect our qPCR results. Those samples will later be compared within each group in a qPCR, which will show the relative levels of expression of Dio3. In addition, a Western blot will confirm our results from the qPCR because they should show similar change in levels of Dio3. The prediction of change of level of T4 will be later confirmed by radioimmunoassay.

R11

Narrative Abilities in Children

Presenter(s)

Sabrina Song, Illinois Mathematics and Science Academy

Advisor(s)

Ozlem Ece Demir, University of Chicago

Susan Goldin-Meadow, University of Chicago

Few studies have explored the narrative abilities of brain injured children. The studies that have been done have only been simple tests of vocabulary or tests that require children to retell a known story in their own words. The current study aims to examine the nature and extent of plasticity in pre- or peri-natal (PL) brain injured children by examining these children's performance on narrative tasks and comparing the data with data from typically developing (TD) children doing the same tasks. Narratives are an ideal context to explore the nature of plasticity in PL children because the narrator must pay attention to a variety of aspects of language such as linguistic structure, narrative structure, and evaluation of the narrative content. Our results show that TD children produced longer stories and more goal-based stories than PL children. These results can lead to one of three conclusions: PL children could have specific problems with narratives, problems understanding and creating goals, or just have a general language problem. Further research needs to be done in order to determine which of these conclusions is correct.

R12

Accessibility of Eponymous Verb Phrases Following Time Intervals

Presenter(s)

Yuchen D Sun, Illinois Mathematics and Science Academy

Advisor(s)

David Rapp, Northwestern University

Many words have multiple meanings. For example, boxer can mean both fighter and a type of dog. Because definitions of words occur more or less frequently, they can have dominant and subordinate interpretations. Dominant interpretations are readily accessible during reading, even when story contexts do not support that meaning. Subordinate interpretations are accessible when contexts support that interpretation. Do ambiguous phrases share such characteristics? For example, the eponymous verb phrase "to pull an O.J. Simpson" can have several meanings (for example, to do harm to your wife or spouse or to play football.) This project examines how different interpretations are retrieved during processing of these types of ambiguous phrases. In preparation for the experiment twenty-five names were normed, and clear dominant and subordinate interpretations were established. Participants will then read stories biasing interpretations towards dominant or subordinate. A paraphrase supporting one of the interpretations will follow the story. Readers will rate these paraphrases from 1 (disagree) to 4 (agree), either immediately after reading, or after a time delay. Participants will complete a distracter test of either short or long duration, and then be presented with a paraphrase interpretation. This project examines the degree to which particular interpretations remain accessible after time delays, and how that affects the availability of ambiguous definitions.

R13**Perceptual Cues of Social Grouping****Presenter(s)**

Vaishali Umrikar, Illinois Mathematics and Science Academy

Advisor(s)

Joan Y. Chiao, Northwestern University

Steven Franconeri, Northwestern University

When we view people in social situations, we sometimes involuntarily assign people to one group or another based on their perceptual features. This investigation tested two perceptual cues, mutual eye gaze and race, to determine how they affect the social grouping processes. Faces were placed at the four corners of an invisible square, and the faces were grouped either horizontally or vertically, either by mutual eye gaze or by race. Following the faces, two letters were presented at two of the four positions. Subjects indicated whether the two letters were identical or not. If the faces grouped together, then responses to the letter task should have been faster when the direction of the face grouping (horizontal or vertical) was congruent with the placement of the letters. If the faces did not group, then the arrangement of the faces should have had no effect on the letter judgment. Pilot results showed that both eye gaze and race do significantly impact the social grouping processes; subjects responded faster and more accurately when the letter positioning matched the face grouping. These pilot results suggest that both gaze direction and race are processed quickly and automatically and are involuntarily used to create social groups.

R14**Do You Remember Information When You Make a Random Guess: An Implicit Memory Study****Presenter(s)**

Robert Washington, Illinois Mathematics and Science Academy

Advisor(s)

Ken Paller, Northwestern University

A common view of remembering is that it implies a conscious awareness of retrieved knowledge. Memory can also occur without awareness of memory retrieval, this is referred to as implicit memory. Prior research suggests that recognition of color patterns sometimes results from implicit memory (Voss, Baym, & Paller, unpublished results). We asked whether accurate memory on a number-string recognition test could be driven by implicit memory. Volunteers in this experiment tried to learn random numbers strings shown briefly on a screen either while being distracted by spoken digits or without that distraction. We predict that recognition will be accurate for numbers learned with distraction, which would suggest that implicit memory is at work. Initial results showed that accuracy was very poor, so changes were made to make the test easier. Preliminary data suggest that implicit memory is indeed being utilized. A key analysis focused on results from people who were more accurate than 50%. Recognition performance was superior when learning occurred with distraction compared to learning without distraction. The results thus show that implicit memory can support accurate recognition following distraction, when conscious memory is typically very poor.

R15**The Preference of Race During Mate Selection and Influences Behind Mate Selection in Asian Americans and Caucasian Americans****Presenter(s)**

Feiyang Ye, Illinois Mathematics and Science Academy

Advisor(s)

Bobby Cheon, Northwestern University
Joan Y. Chiao, Northwestern University

Caucasian and Asian Americans currently make up the largest proportion of interracial relationships in America. With that observation in mind, we were interested in determining whether Caucasian or Asian Americans valued race more during mate selection and why one group found it more important than the other. We conducted an online survey to find the most valued mate preferences of these two groups and which factors could have influenced their preferences. The possible influences included relationship with parents, acculturation for Asians, self-construal style, and ethnic identity. To measure the value of mate preferences, we designed a rating scale. Influences were measured by demographic questions, the Self-Construal Scale, the Multigroup Ethnic Identity Measure, and the Suinn-Lew Asian Self-Identity Acculturation Scale. Results indicate that Asian Americans value dating within their race more than Caucasian Americans. The preference of dating within the same race for Asian-Americans is positively correlated to their willingness to discuss relationships with their parents. Asian Americans who do not value dating within their race tend to believe that other races are more attractive and Caucasians are the dominant race in America. Neither group showed significantly more interest in specifically dating outside of their race, which was expected.

R16**Using Congenic Rats to Determine Genetic Contribution to Coping with Stress****Presenter(s)**

Jenny Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Eva Redei, Northwestern University Feinberg School of Medicine

The purpose of this project is to use congenic rats to determine possible X-linked genes that contribute to depression. F344 and WKY strains are selected as animal models of normal and depressive behavior due to their phenotypical differences in coping with stress. Attention to specific X-chromosome regions is based upon previous QTL analysis, which presented strong evidence that the selected regions affect coping behavior. Congenic lines are derived through selective breeding based on rules of inheritance and genotyping results. Phenotypes of congenics are determined through behavioral test scores. When comparing scores to those of pure strains, it can be determined whether or not the congenic locus significantly affects coping behavior. Behavioral tests conducted include forced swim, defensive burying (DB), elevated plus maze, and open field tests. In DB test, loci such as Got217, and Wox17 exhibited significant score differences in different congenics, proving loci's correspondence with coping behaviors. Instances in need of further investigation include End and Rat17 congenics, which exhibited phenotypes of background DNA instead. More defined mapping of loci borders are needed in order to ensure that gene affecting coping behavior is completely within congenic region of all offspring. Further studies involve examination of specific gene expression levels in congenics in order to experimentally alter levels of gene expression.

S01**Evaluating HIV Tests for Use in Tanzania****Presenter(s)**

Amy Allen, Illinois Mathematics and Science Academy

Advisor(s)

Timothy Feddersen, Northwestern University

My investigation is part of the Global Health Initiative, a partnership between Northwestern University, several drug companies, and the Gates Foundation, which addresses public health issues in developing countries. Dr. Tim Feddersen will be traveling to Tanzania this spring as part of GHI's plan to introduce new HIV diagnostic tools in the Tanzanian market. The goal of my project is to issue a recommendation for GHI about whether or not diagnostic tools for HIV are a worthwhile investment, and, if so, if the infant test would be the best to introduce in Tanzania. So far, I have conducted a review of literature and interviewed many specialists in the field of public health. From my reading and interviews, I have become more knowledgeable about the extent of the HIV epidemic in Tanzania and which populations are most affected, as well as the functioning of the tests themselves. I have also begun to develop a set of criteria for evaluating the available HIV tests. Possible criteria include whether funding would be diverted from other areas of public health, the tests and treatment available for those who are diagnosed, and the question of which populations would benefit most from diagnosis and treatment.

S02**Teasing: What Separates the Victims from the Unaffected****Presenter(s)**

Erika Bongen, Illinois Mathematics and Science Academy

Advisor(s)

Christopher Kolar, Illinois Mathematics and Science Academy

Deborah McGrath, Illinois Mathematics and Science Academy

There is no denying that teasing is a big problem that the majority of children face sometime in their school career. However, the more illusive question is what separates scarred victims from those who survive with barely a scratch. I conducted a survey of the IMSA population and asked them how frequently they were teased. I also asked questions about different social and personality traits such as: How many grades older than you is your closest older sibling? or Do you have a humorous personality? Then, I analyzed the difference between the participants who were teased often and those who were teased rarely. My survey resulted in finding that traits like hot temper or number of friends did not make a difference. The only trait that affected whether or not one was teased frequently was social skill. The group that was rarely teased had greater social skills than the group that was teased often. Overall, whether or not one is teased a lot depends on one's social skills. This makes sense because even if one has the comedic talent to drive away teasing, one must have the social skills to know when and how to use it.

S03

Optimizing And Integrating An Ideal Leadership Development Program

Presenter(s)

Kelsey Gee, Illinois Mathematics and Science Academy

Sammy Nammari, Illinois Mathematics and Science Academy

Advisor(s)

Robert Hernandez, Illinois Mathematics and Science Academy

Optimizing and integrating an ideal leadership development program for a community like IMSA requires background knowledge of different leadership models, the way leadership education has been approached in other environments, and forms of assessment. Building off of past research related to leadership education competencies and assessment, we organized a matrix of the core components, objectives, and definitions of an optimal leadership development program. This matrix divided the five competencies of foundational leadership knowledge, self-development, working in groups, community dynamics, and making positive change into specific and attainable objectives that could be integrated into programs or curricula. Using this matrix, we identified assessment tools that would appropriately gauge progress in the five main areas and analyzed programs at IMSA for their contribution to the leadership environment here on campus. With our analysis, we have identified the competencies that various IMSA programs approach successfully as well as those that demand future changes in curriculum, and compiled recommendations for assessment tools that can better measure leadership development in IMSA students.

S04

Sociology of the Internet

Presenter(s)

Christian Gines, Illinois Mathematics and Science Academy

Advisor(s)

David Evenson, Illinois Mathematics and Science Academy

This study examines the Internet and the impact it has on communication between people through analysis of various literature and past surveys, creating a model of social interaction and its affects on people. The implications of the study demonstrate that people are more influenced today by the Internet than ever before. Communication and social skills have increased between people online because self esteem increases. The Internet has helped breakdown barriers and stereotypes of people from different countries. People agreed that the Internet has been a positive addition in their lives. These results suggest that the Internet significantly influences people's ideas and interactions through social networking. Other results suggest that negative issues such as depression and loneliness decrease over time because of online social support. Results have also shown trends among users such as an increase in women using the Internet while before it was regarded as generally being male dominated. Current data is being used to develop a preliminary model of social interaction, taking into account correlations of social networks, relationships, the conduct of these interactions, the effects of these interactions, and the purpose for using the Internet. The relevance of these studies is seen worldwide as people identified as Internet users organize social movements and protests to protect their right to communicate on a free network.

S05**The Arctic Circle: Future Existence and Ownership of Earth's Northern Ice Cap****Presenter(s)**

Eric Hultgren, Illinois Mathematics and Science Academy
Cody Morrow, Illinois Mathematics and Science Academy

Advisor(s)

Paavo Husen, Illinois Mathematics and Science Academy

The recession of world ice caps has focused attention on previously unexplored Arctic lands and seabeds because of interest in potential sea routes and caches of untapped natural resources. Our study investigated the environmental, geopolitical, and economic implications of the race to claim the Arctic. The United States, Russia, and Canada have all been actively exploring and mapping the seabed of the North Pole, with intentions of claiming the Arctic. Denmark and Norway, two other contending countries, are not as far along with their research. All claims are subject to international regulations and roadblocks from The Law of the Sea Treaty (LOST). This treaty allows for a country to claim territory within ten years of its signing. While Russia's 2009 deadline approaches, the United States has yet to even sign the treaty. Our presentation will discuss several possible outcomes: the United States could ratify the LOST and submit its own claims; Russia's claims could be approved by the United Nations; or, the Arctic could be divided amongst the contending countries.

S06**A Long-Standing Debate: Race-Based Affirmative Action in College Admissions****Presenter(s)**

Catrina Kim, Illinois Mathematics and Science Academy

Advisor(s)

Jim Victory, Illinois Mathematics and Science Academy

In June 2007, the US Supreme Court heard its most recent affirmative action case. It was a decision that shaped the struggle that IMSA students face when they apply to college. My original hypothesis was that a majority of IMSA students are against race-based affirmative action in college admissions. However, a number of my classmates acknowledged the merits of race-based affirmative action even though these policies would probably affect them adversely. With my advisor, Dr. Victory, Dr. Scheppler, and Mr. Kolar, I created an online survey. I sent it to the IMSA student body and received 214 responses. To measure IMSA students' understanding of affirmative action, I wrote a free response question asking students to describe how colleges employ race-based affirmative action. To evaluate responses, I created a rubric with essential elements of affirmative action. Using the Kruskal-Wallis test for variance, correlation analyses, and simply taking percentages, I analyzed the responses. Surprisingly, very few students understood race-based affirmative action. Thirty-two claimed that affirmative action was based solely on filling quotas. Such specifics point to the bigger picture: although IMSA students are affected by affirmative action, they have a limited understanding of such policies.

S07**Looking From the Outside In: The Process of Organizational Transformation****Presenter(s)**

Jonathan Koch, Illinois Mathematics and Science Academy
Gouthami Rao, Illinois Mathematics and Science Academy

Advisor(s)

Glenn "Max" McGee, Illinois Mathematics and Science Academy

Many organizations have undergone major changes that often affect the fundamental processes on which the organization runs. These large-scale, transformative changes, when successful, result in increased productivity, engagement, and satisfaction. Interviews were conducted with leaders of organizations that have undergone successful transformations: the Illinois Education Association, Tilton Elementary School, Joliet Township High School, and the NTI Group, Inc. The data collected provided insight into transformative change and the commonalities among organizations. Ultimately, each institution successfully modified itself through a novel, communal process based on the conditions of goal-setting, communication, and accountability. Additionally, at a time when the Illinois Mathematics and Science Academy seeks transformational change, surveys and a focus group were used to determine the community's perception of the school's new Strategic Plan in creating change. Results were compared to existing research as well as field data from the successfully transformed organizations. From this comparison, recommendations will be made to the IMSA Board of Trustees and administration regarding the implementation of the Strategic Plan to increase its probability for success.

S08**Media's Role in the Present-Day United States: Beyond the News****Presenter(s)**

Donald Lee-Brown, Illinois Mathematics and Science Academy

Advisor(s)

Claiborne Skinner, Illinois Mathematics and Science Academy

This project initially tried to examine bias in America's media system. However, it was concluded that bias in the media does not actually exist, due mostly to a highly commercialized system free of official state interference. In actuality, media in the United States is a market driven system of subcultures that play off each other in order to garner new consumers. This lack of a coherent national voice creates a plethora of smaller issues within subcultures, ranging from assault rifles for everyone lobbies to vehement opposition to the whale killing ultra low frequency Navy sonar. This media fragmentation, however, makes it possible for politicians like Mike Huckabee to effectively target a group and garner votes. America's media system is not biased in the macro, but rather is a conglomeration of opposing interests seeking to turn a buck.

S09**The Changing American Landscape: Latino Demographics of the 100 Largest US Cities****Presenter(s)**

Josue Pernillo, Illinois Mathematics and Science Academy
Gustavo Ulloa, Illinois Mathematics and Science Academy

Advisor(s)

Juan Andrade, US Hispanic Leadership Institute
Michael Rodriguez, US Hispanic Leadership Institute

The purpose of the United States Hispanic Leadership Institute (USHLI) is to fulfill the promises and principles of democracy. USHLI does this by empowering disenfranchised groups, while maximizing civic awareness and participation in the electoral process. We created demographic profiles for Latinos in the one-hundred largest US cities, using data from the 1990 and 2000 Decennial Census and from the 2005 American Community Survey. With it, we compared the demographics of other ethnic communities to that of Latinos, using twenty-two different variables. An example is the racial composition of Chicago. From 1990 to 2005 the number of Hispanic in the city of Chicago increased by 232,382 persons (42.5%) while the overall population decreased by 81,800 (2.9%). The more Latinos in the city, the more influence they would have on the city's politics. This is reflected in the statement "The Latino community is changing the complexion of cities and states from coast to coast and that is transforming American politics (Andrade, 2006)." Trends in other large US cities were uncovered and will be presented. We therefore hope to empower the Latino community using this data because knowledge is power.

S10**Homosexuality and the Catholic Church****Presenter(s)**

Michael Reeks, Illinois Mathematics and Science Academy

Advisor(s)

Melissa Browning, Loyola University
Patricia Jung, Loyola University

Among the most explosive political, social, and religious issues in our modern world is that of homosexuality, or rather of its moral value. Is it right? Is it natural? When examining the roots of this problem in history, it becomes clear that the role of the Roman Catholic Church in its development cannot be overstated. This project aimed to examine exactly how Catholicism influenced popular and intellectual views of homosexuality, and how its current stance on the issue developed. Using a reading of many of the Church's founding theologians, this paper will show that, while homosexuality has generally always been considered a sin, the justification for this anathema has varied. More specifically, it has grown somewhat harsher, evolving from St. Augustine's view of all sexuality as a distraction from God to Cardinal Joseph Ratzinger's (recently, Pope Benedict XVI) denunciation of the practice on moral grounds, from a mere cause of sin to a sin in itself. It was discovered that the introduction of Levitical Law into the Western world through Christianity also brought homophobia, and that the decay of Socratic and Platonic schools of thought in the medieval age made stricter its justification and its results. The examination of the history of this trend will hopefully allow for a greater understanding of the problem and a step towards its reconciliation.

S11

Web Searching Skills of the Average Young Adult

Presenter(s)

Tabitha Mei Walquist, Illinois Mathematics and Science Academy

Advisor(s)

Eszter Hargittai, Northwestern University

My focusing question is: What is the web-searching skill level of the average young adult, and how can we develop a successful program to help students search the web more efficiently? The Web Use Project went to the University of Illinois at Chicago and collected data from a diverse group of young adults about their online information seeking behavior through screen captures and videos, and audio of the subject and interviewer. Interviewers asked the subjects to perform a list of twelve tasks, ranging from finding a passage in a play, to finding a map of Darwin's voyage, to providing subjects with a description of an object and asking them to find the name of the object. I coded the data for the three tasks described above. Coding is defined as identifying recurring variables in a qualitative data set and presenting them in a spreadsheet, so that information about multiple users can be aggregated and compared quantitatively. After coding the data, we noted recurring and interesting inefficiencies. For instance, while looking for a scene from *Romeo and Juliet*, some subjects went to a site that had "study guide" in the description, which did not aid in the completion of the assigned task. I also evaluated the subjects' success in the task and found that some people had never encountered certain tasks and did not know how to approach them. I found most UIC students' skills were not as advanced as I would have expected, and could be improved by a web searching seminar or training session.

S12

A Comparison of Healthcare Policies in China and Sweden

Presenter(s)

Jing Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Christian Nokkentved, Illinois Mathematics and Science Academy

China and Sweden have undergone reforms in their welfare systems since the 1980s, introducing market mechanisms into their public health systems and decentralizing financial responsibilities. Whereas Sweden ranked twenty-third in overall health system performance according to a 2000 World Health Organization ranking, China placed 144th. This study compares the welfare policies of Sweden and China while trying to understand how both systems function. Chinese healthcare has seen a serious decline in equity of care since the central government dismantled the Cooperative Medical System and decentralized fiscal responsibility to local authorities, which are supported by local taxation. The new system favored wealthy, industrialized urban areas, neglecting the poor rural regions where 75% of China's population resided in the 1980s. Swedish healthcare policy, on the other hand, has stressed the importance of equity since the 1992 Health and Medical Services Act and includes regulation on allocation grants to local governments to maintain similar standards amongst localities. The Chinese and Swedish systems differ in equity of care and policy regarding physical resources and healthcare finances because as a developing nation, China does not have the benefits of an equally industrialized state, which Sweden maintains. Chinese healthcare must address the disparities inherent in an unequally industrialized state and an inadequate development in policy.

T01**Light Intensity with Respect to Altitude****Presenter(s)**

Christopher Gropp, Illinois Mathematics and Science Academy

Advisor(s)

Geza Gyuk, Adler Planetarium

The purpose of this investigation is to measure light intensity from the Sun (the solar constant) as a function of altitude. We are doing this not only to examine in detail how the atmosphere works, but also to help design components of small satellites for a later program. We are currently working with a photoresistor circuit to measure light intensity. The circuit does this by measuring the amount of time it takes to drain a capacitor using the photoresistor, the resistance of which is dependant on light intensity. This circuit is attached to a balloon payload and is then launched into the atmosphere. The maximum height reached by the balloon is approximately twenty miles from the surface. At this altitude, the balloon is at the edge of space, above 99% of the atmosphere. Challenges with this experiment include recovering the balloon payload, correlating light intensity measurements to specific altitudes, and making sure that the payload survives at -50 degrees Fahrenheit. As of yet, no launch has been successful, largely due to weather conditions, but each design has been better than the last. Even if no data is gathered, the experience will prove useful as Adler Planetarium develops a space program.

T02**Weak Lensing Mass Estimates of Low Redshift Galaxy Clusters****Presenter(s)**

Frances Hardin, Illinois Mathematics and Science Academy

Kelsey Lawhorn, Illinois Mathematics and Science Academy

Anthony Yunker, Illinois Mathematics and Science Academy

Advisor(s)

James Annis, Fermi National Accelerator Laboratory

Donna Kubik, Fermi National Accelerator Laboratory

Jeffrey Kubo, Fermi National Accelerator Laboratory

Huan Lin, Fermi National Accelerator Laboratory

Albert Stebbins, Fermi National Accelerator Laboratory

Gravitational lensing is the bending of light by massive bodies. Weak gravitational lensing is detected through a statistical analysis of the background galaxies. Mass estimates from lensing depend only on the mass of the object, unlike other methods, making lensing particularly useful. Most weak lensing studies use clusters with redshifts of 0.2 or greater, but large sky surveys such as the Sloan Digital Sky Survey (SDSS) lend themselves to greater angle studies of lensing, so we began a study of low redshift clusters. We selected twenty-two clusters from the c4 and Berlind catalogs and calculated the shear caused by each cluster using data from the SDSS DR6. Then we fit a Navarro-Frenk-White profile to this shear and derived an estimate of the mass within the virial radius for each cluster. We analyzed twenty-two low redshift ($z \leq 0.12$) clusters, most of which did not have previous estimates. Out of twenty-two clusters, at least six were successes, giving at least a 30 percent success rate. These mass estimates were dependent only on the mass and were the first such analysis performed on these clusters. These analyses have showed that the SDSS is a feasible source of lensing signal for these low redshift, large angle clusters of galaxies.

T03**Deconvolution of the Photometric Redshift Distribution in Fourier Space****Presenter(s)**

Sapna Patel, Illinois Mathematics and Science Academy

Jennifer Roderick, Illinois Mathematics and Science Academy

Advisor(s)

Carlos Cunha, University of Chicago

In recent years, technology has allowed us to look back into the past, revealing the Universe's most intimate secrets. Today we know that 96% of the Universe is in exotic forms that we call dark matter and energy. It has been proven that due to these components, our Universe is expanding at an accelerating rate. Measured redshifts can be used to reconstruct this expansion and evolution of the Universe. For our investigation, we created a computer program to calibrate the errors caused by estimating redshift distributions photometrically. The program improves photometric estimates of the redshift distribution by using deconvolution and Fourier techniques to remove the noise from the data. Our program first Fourier transforms the photometric redshift distribution as well as the error matrix. It then removes the error and inverse Fourier transforms the cleaned data and error matrix. Lastly, it deconvolves the data and converts it back into normal space. The final output contains the estimate of the true redshift distribution in the Universe. Our developed methods improve existing techniques of photometric estimation and reveals invaluable data that will help solve the mysteries of dark matter and dark energy.

T04**Multi-Wavelength Investigation of Active Galaxies****Presenter(s)**

Nathaniel Simpson, Illinois Mathematics and Science Academy

Advisor(s)

Geza Gyuk, Adler Planetarium

David Steele, Adler Planetarium

At the Adler Planetarium I undertook a multi wavelength investigation of active galactic nuclei (AGN). The reason why these galaxies are called active is because of a super massive black hole at the center which emits jets of particles and radiation. AGN whose jets are orientated towards the Earth are called blazars. The particles in an AGN jet radiate photons of all wavelengths in the electromagnetic spectrum, including optical light and very high energy gamma rays. Correlations between AGN emissions at different wavelengths provide information about the physical processes at work in the jet. To study blazer emission versus time, I downloaded optical data from the WIYN .9m telescope on Kitt Peak in Arizona, collected September 2007 to December 2007, to the servers at Adler, and then manipulated the data using a program called IRAF. This allowed me to do photometry, or to determine the optical brightness of each objects versus time. I also obtained gamma ray data collected with the Whipple 10m telescope on Mt. Hopkins, Arizona for the same sources in the same periods of time and searched for correlations between the optical and gamma ray emission.

U01

Comparison of Gender Role Beliefs Between IMSA and Non IMSA Christian Students

Presenter(s)

Meredith Rhein, Illinois Mathematics and Science Academy

Advisor(s)

Grace Glass, Illinois Mathematics and Science Academy

The religious impact on gender roles, especially on female roles, can be observed in the past, present, and will be seen in the future. Christianity, as the world's largest religion, influences many people and I investigated how IMSA students embrace Christianity's projected gender roles differently than non-IMSA high school students. In this study, questionnaires were used to survey random female and male, IMSA and non-IMSA students to investigate their Christian experiences and views of gender roles. The resulting analysis of questionnaire response provides proof that IMSA females and males do tend to have more contemporary gender role beliefs and ideas than non-IMSA females and males. IMSA females and males also tend to conform to fewer Christian ideals about their future roles than non-IMSA students. The questionnaires show that both IMSA and non-IMSA males and females are influenced mainly by male leadership in their Church's faith. Also, the majority of IMSA and non-IMSA male and female students tend to admire males in the Bible. These findings suggest that math and science orientated students have a more equaled and contemporary view of men and women, but ultimately more research, possibly surveying a larger sample size, is needed to estimate to what degree.

U02

A Spectrum of Religions: An Analysis of the Role of Religions in the Twentieth Century's Most Difficult Novel

Presenter(s)

Shuang Zhang, Illinois Mathematics and Science Academy

Advisor(s)

Dennis Czerny, Illinois Mathematics and Science Academy

Thomas Pynchon's *Gravity's Rainbow*, which is recognized as one of the most difficult novels in twentieth century American Literature, mentions many sorts of religions, from popular religions like Christianity to those that are only observed in Africa, such as the religion of the Hereros. Pynchon uses religions as tools to describe his satiric view of the world as well as to further explain his objective in writing the 760-page novel. In this investigation, I compared the religions mentioned in the book and looked at how each of them plays a different role in the complexly interwoven storyline which includes more than 400 characters. Pynchon successfully shows in the story that many religions actually share common beliefs even when they are geographically far apart and their cultures are very different. Similar but different, these two religions motivate the characters to action. By including the aforementioned theme in his novel, Pynchon shows the complexity and ironies of the twentieth century in regard to race and religion. Many people still consider religions that they are not part of as inferior to their own. I believe that presenting these findings will change the way people view such "inferior" religions.

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A09	37	Bani Saluja	1:20	A-135
M03	82	Ashima Sarup**	10:25	AP A-138
J03	75	Kyle Schirmann	1:20	A-113
P12	100	Jonathon Schwarzbauer	11:15	B-110
B04	40	Jasmine Shah	10:25	B-116
C20	50	Shailee Shah	12:30	B-116
C21	51	Jianning Shao	10:50	B-133
O16	93	Sarah Shareef*		
O17	93	Hyun Soo Sheen	10:00	A-133
K03	76	Alan Shen***	10:25	LH B-206
G02	62	Bo Shi	10:50	E-115
N03	84	Eric Shyu	1:20	A-147
T04	120	Nathaniel Simpson	11:15	A-117
O10	90	Gaurav Singh	11:15	A-131
C22	51	Edward Song	1:45	A-149
G05	63	Ellen Song	12:55	A-151
R10	109	Karen Song	10:25	A-119
R11	110	Sabrina Song	09:10	A-117
B03	39	Sonny Song	09:35	A-131
I01	67	Shaine Strullmyer	2:10	D-103
R12	110	Yuchen D Sun	12:30	B-133
E05	57	Erin Talbot	1:20	A-133
A10	37	Isaiah Tan	10:00	B-110
P04	96	Velin Tchalakov	09:10	D-103
A01	33	Jessina Thomas	10:50	A-149
R07	108	Laura Thompson	1:45	LH B-206

P10	99	Robert Till	10:50	A-133
C23	52	Shobha Topgi	12:55	A-155
O13	91	Sarah Trevor	11:15	B-116
N04	85	Justin Troyka	10:25	D-110
K03	76	Timothy Truong***	10:25	LH B-206
P13	101	Katherine Tu	1:45	D-107
D02	54	Margaret Tu	1:20	A-117
E06	57	Ruhiyyeh Turner	09:35	A-133
P14	101	Milan Udawatta	10:50	D-110
C24	52	Thiran Udawatta	11:15	D-103
S09	117	Gustavo Ulloa	1:20	AP A-138
R13	111	Vaishali Umrikar	2:10	B-133
P01	95	Anil Vaitla	1:45	A-131
L07	81	Thomas Vandiver	2:10	D-107
C12	46	Karthik Vantakala	2:10	A-117
O04	87	Arika Verma	1:45	B-116
B05	40	Alisha Vimawala	12:55	B-116
I11	72	Anisha Vyas	09:10	D-107
S11	118	Tabitha Mei Walquist	10:00	D-107
Q06	104	Francis Walsh	2:10	A-155
G01	61	Ryan Wang	12:30	LH B-206
R14	111	Robert Washington	12:55	B-133
K05	77	Patricia Whittaker	1:20	E-115
L03	79	Alyssa Winans	2:10	D-110
G06	64	Mark Xue	09:10	A-133
R15	112	Feiyang Ye	1:20	LH B-206
O18	94	Jisun Yoo	09:35	E-115
H05	66	Valerie Young	10:00	A-149
O19	94	Eva Yuan	10:50	A-151
T02	119	Anthony Yunker	09:10	A-151
I12	73	Brandon Zhang	10:25	E-115
R16	112	Jenny Zhang	09:35	A-119
S12	118	Jing Zhang	10:00	A-155
C25	53	Ruijie Zhang	11:15	A-147
U02	121	Shuang Zhang	1:45	A-155
I13	73	Terence Zhao	09:35	D-107
C26	53	Jiabo Zheng	1:20	A-155

* the student's oral presentation will not occur at IMSAloquium

** presentation has a double time block scheduled

*** presentation has a triple time block scheduled

LH = Lecture Hall B-206

AP = Academic Pit A-138

