Mathematical Association of America
MD-DC-VA Section, April 25-26, 2014
James Madison University – Harrisonburg, Virginia
Abstracts

Abstracts for the workshop and invited addresses are listed first, in chronological order, followed by faculty and graduate student abstracts, alphabetized by submitting presenter's last name. Student presentation abstracts follow, with student poster abstracts at the end (all alphabetized the same way).

Invited Addresses

FRIDAY WORKSHOP

Laura Taalman, James Madison University

3D-Printing Mathematics Objects

2:00 PM Session 1, 4:00 PM Session 2, Burruss Hall, Room 349

In this workshop we will discuss various 3D-printed mathematical objects and methods for modeling such objects in Mathematica, TopMod, and OpenSCAD. Participants will have hands-on use of the 3D printers in the JMU 3-SPACE 3D printing classroom, and will construct and print their own models during the workshop. We will also discuss equipment, safety, and other practical matters for participants who wish to establish 3D printing labs or classrooms in their own mathematics departments and institutions.

BANQUET ADDRESS

Roland Minton, Roanoke College

Mathematical Mystery Tour

8:00 PM, Festival Conference Center, Ballroom

In the spirit of Martin Gardner and Math Awareness Month, an eccentric collection of mathematical tidbits will be presented. There will be mathematical magic tricks, including perhaps the oldest (mathematical) trick in the book. There will be historical diversions, including perhaps the oldest (mathematical) game in the book. There will be more odd, even, and hopefully interesting ideas.

SATURDAY INVITED ADDRESSES

Matthew Pons, North Central College

Three Things that Don't Really Go Together

9:45 AM, Health and Human Services Building, Room 2301

In three short segments, we will investigate several topics which all undergraduate mathematics majors know to be true (or trust in the existence of), but many of whom graduate without experiencing in a rigorous fashion. Our goal is to consider the following questions: Why is *e* irrational? Can we identify elements in the Cantor Set? How does one construct a function which is continuous everywhere but differentiable nowhere? These are topics that every math major should know, really know.

Bruce Torrence, Randolph-Macon College

The Lamp Lighting Problem

4:00 PM, Health and Human Services Building, Room 2301

> *Early one morning a janitor is walking through a museum, trying to turn on the light in every room. However, the electrical connections are a bit tricky. In every room there is a button, and pushing the button toggles the light on/off not only in that room, but also in all adjoining rooms! Can the janitor light up every room in the museum?*

The lamp lighting problem is a beautiful mathematical exercise lying at the nexus of graph theory and linear algebra. It is based on a theorem whose history is both fascinating and sordid: many have "discovered" and published it over the past three decades. The problem itself has a similar knack for cropping up, having appeared under various guises in the

problem sections of *The Mathematical Intelligencer* and *Mathematics Magazine* (twice!). We will take a stab at coming to terms with the result, proving it at least twice along the way, with the aim of showing how each approach sheds light on the others. We also hope to shed enough light on the theorem itself to deter others from claiming it as their own.

Contributed Faculty Papers by Author

Abdinur Ali, Norfolk State University
Mushtaq Khan, Norfolk State University
Cloud Computing and New Trends in Mathematics of Cryptography
2:15 PM, Health and Human Services Building, Room 2202
Today, we get our electricity, water and heating from utility companies. In the near future, the Cloud computing companies will provide data storage and computation services to the customers in the same manner. The companies will not need to have large IT departments. All the IT work will be delegated to the Cloud. It might be appealing to have access to unlimited storage without the worry of buying tons of hardware devices. It is also advantageous not to worry about constant anti-virus software updates and installations of new software versions. However, the security of the data in the Cloud will be a major issue. The customers can download from or upload encrypted data into the Cloud. Encryption of the data might stop data snooping but it will limit the processing of the data. The goals of these new mathematical techniques are to enable the customers to process encrypted data in the Cloud while it is encrypted and receive encrypted answers from the Cloud. These new mathematical techniques will insure the security and privacy of the data in the Cloud. This talk will cover Elliptic curve and double layer encryption cryptography.

Raji Baradwaj, University of Maryland, Baltimore County
Matthias K. Gobbert, University of Maryland, Baltimore County
Liz Stanwyck, University of Maryland, Baltimore County
Nagaraj K. Neerchal, University of Maryland, Baltimore County
Implementation of Course Redesign to Improve Student Learning Outcomes
8:50 AM, Health and Human Services Building, Room 2202
Precalculus is a challenging course because it develops critical math skills for students coming from diverse backgrounds. We used course redesign to improve student learning outcomes as well as to help students establish study techniques that will enable them to pass the calculus sequence. Specifically, one of the three credits of lecture is converted to a guided team-based active learning environment. In Fall Semester 2013, the number of students earning a D, F, or Withdraw, decreased by 10% compared with Fall Semester 2012. This talk focuses on the logistics of course redesign using our Precalculus course as example.

Bud Brown, Virginia Tech
Difference Sets, Singer Designs, and Singer Difference Sets
8:25 AM, Health and Human Services Building, Room 2209
A (v,k,λ) difference set is a set of k elements in a group G of order v such that the set of nonzero differences d_i - d_j contain λcopies of the set of nonidentity elements of G. For example, {1,3,4,5,9} is an (11,5,2) difference set for the group $\boldsymbol{Z}$ mod 11. This talk is about an interesting connection between certain difference sets (called Singer difference sets) and certain block designs that appear in finite projective geometries (called Singer designs) -- and about James Singer, for whom these combinatorial objects are named.

Elizabeth Brown, James Madison University
***An Accessible Proof of the Existence of an Uncountable Antichain in* P(N)**
3:30 PM, Health and Human Services Building, Room 2209
That there exist uncountable anti-chains in the power set of the natural numbers is a mysterious proposition on first consideration. In this note, we present a proof of the existence of such an anti-chain that is comparable in simplicity to other proofs from introductory real analysis courses; it could be given as a guided discovery homework problem, for example. This talk will be suitable for those teaching or taking undergraduate real analysis.

Lihua Chen, James Madison University
Panayotis Giannakouros, James Madison University & University of Missouri, Kansas City
Entropy, Data Compression, and Model Combination
3:30 PM, Health and Human Services Building, Room 2202
We will review the principle of Minimum Description Length as used in data compression and statistical modeling. We will examine how some insights from data coding and compression lead to an adaptive model mixing technique.

Boyd Coan, Norfolk State University
Cherng-tiao Perng, Norfolk State University
Some Fun with Euclidean Geometry
8:00 AM, Health and Human Services Building, Room 2208
In an article in the June 2013 issue of Mathmedia of Academia Sinica, B. Liu gave a proof of the "Theorem of Three Sets of Parallel Lines" showing the equality of areas of two triangles with vertices at the intersection of certain lines from these given sets. He conjectured that a generalization of this theorem is true for any n sets of parallel lines when $n>3$. His experiments with The Geometer's Sketchpad appear to confirm the cases $n=4$, 5, 6 and 7, i.e. that the areas of the two n-gons involved are the same. In this talk, we give a simple algebraic proof of his conjecture for the case of any $n>3$, under the assumption that the corresponding points of intersection of the different sets of parallel lines in his formulation do form well-positioned n-gons.

Bryan Faulkner, Ferrum College
Shooting Turtles in the Classroom
8:50 AM, Health and Human Services Building, Room 2204
In the late nineteenth century Eduard Lill developed a graphical method for determining the value of polynomial functions. More recently, Thomas Hull has used Lill's method along with paper folding to construct the cube root of 3. This presentation will show how Lill's method relates to paper folding. We will also discuss how these ideas can be used in a class studying polynomial functions.

Barbara Franklin, James Madison University & Morgan State University
Understanding the Success and Failure of African American First Time Developmental Mathematics Students: A Racialized Perspective
2:40 PM, Health and Human Services Building, Room 2204
It is well documented that many students who enroll in college are unprepared for the academic rigors of college work, especially students who enroll in community colleges. Students who enter community colleges underprepared in mathematics are required to take developmental mathematics (DVM), and DVM completion statistics are gloomy nationwide. Many of these students are minorities, particularly African Americans, whose dream of a college degree is "a dream deferred" (Hughes, 1951). While some are successful and have moved on to college-level mathematics, many are failing and trapped in DVM or opting out of DVM, or even worse college. The issue is that DVM has become a bit of a monster haunting African American first time community college students, As opposed to being a gateway, DVM is more often a gatekeeper for this group of students. This study aims to examine the success and failure of African American first time DVM students from a critical social theory perspective. It uses critical race theory as a lens to examine the DVM setting proposing that it is a racialized form of experience which informs African American students racial and mathematics identities which influences success and failure for these students. This qualitative study uses classroom observations and student and faculty interviews as examination tools. The results of this study will contribute to literature on race and mathematics education and will enhance our understanding of success and failure in DVM for young African American college students.

Matthias K. Gobbert, University of Maryland, Baltimore County
Raji Baradwaj, University of Maryland, Baltimore County
Liz Stanwyck, University of Maryland, Baltimore County
Nagaraj K. Neerchal, University of Maryland, Baltimore County

Abstracts

Course Redesign as a Strategic Tool to Consolidate Foundation Courses
8:25 AM, Health and Human Services Building, Room 2202
Today's population of many foundational mathematics courses needs significant help establishing their study techniques in addition to the contents of the classes. Course redesign tackles this problem by moving a portion of the traditional lecture time to a guided team-based active learning environment. This talk focuses on the necessary means that a department needs to put in place to enable course redesign to be successful, such as tight course coordination, choice of section size, and cost-neutral funding. The guided active learning initiated in a redesigned class is additionally complemented by identical techniques in our department's Math Gym offered to students outside of class. The initiatives work together by using the same learning techniques and integrated outcome data collection.

Bob Hanson, James Madison University
Regular Polygons in Taxicab Geometry
2:15 PM, Health and Human Services Building, Room 2210
This talk will show that there are no equilateral triangles and no regular pentagons in taxicab geometry. The set of Euclidean squares and the set of taxi squares will be shown to be the same and a method for construction for regular 2*n*-gons will be demonstrated.

Gregory Hartman, Virginia Military Institute
Getting Involved in the Open Textbook Movement
3:30 PM, Health and Human Services Building, Room 2204
In this talk we discuss the growing open-source textbook movement and reasons why one should be interested in adopting, or writing, an open-source text. We introduce the APEX (Affordable Print and Electronic teXtbook) model for collaboratively writing texts. An update will also be given of the APEX Calculus, a "Calc I" through "Calc III" text which is in use at VMI.

Brian Heinold, Mount St. Mary's University
Automatic Differentiation
8:25 AM, Health and Human Services Building, Room 2204
Whenever I teach Numerical Methods, I cover numerical differentiation. The standard approach, based on difference quotients and Taylor series, suffers from some serious floating-point problems. Recently, I came across a technique called automatic differentiation that does not suffer at all from floating-point problems. It is easy to implement and has an interesting tie-in with abstract algebra. I will discuss the method and provide a simple implementation of it in the Python programming language.

Heidi Hulsizer, Hampden-Sydney College
Teaching Introductory Statistics with In-Class Data Collection
3:05 PM, Health and Human Services Building, Room 2210
The Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report recommends that real data be used to teach introductory statistics. In this talk, ideas will be presented that involve collecting data from students for various statistical tests. There will be discussion of how to efficiently collect this data and how to use technology to one's advantage. Pitfalls will be discussed as well.

Ilhan Izmirli, George Mason University
Interval Vectors
8:50 AM, Health and Human Services Building, Room 2209
The exploration of the profound and intrinsic cohesion between mathematics and music is certainly nothing new – it actually dates all the way back to Pythagoras (c. 570 BCE – c. 495 BCE). However, the introduction of the dodecaphonic (twelve-tone) system developed by Arnold Schoenberg (1874 – 1951) around 1908 has taken this study to entirely new levels, and has instituted such concepts as set theory, ordered sets, vectors, and various types of spaces as useful tools in music theory. In this paper we will look into one of these tools: the interval vectors.

Dan Kalman, American University
Companion Matrices and Difference Equations Part 1: Distinct Roots
2:15 PM, Health and Human Services Building, Room 2209
A companion matrix is famous in linear algebra as an answer to the question "Given a monic polynomial *p*, is there a matrix for which *p* is the characteristic polynomial?" But companion matrices have several additional interesting properties that deserve to be better known. In particular, there is a strong connection between companion matrices and difference equations. In this talk I will show an explicit diagonalization of a companion matrix whose polynomial has distinct roots, and use it to solve certain *n*th order difference equations.

Emek Kose, St. Mary's College of Maryland
Art, Mirrors, and Math: A Mathematician's View of Images
3:30 PM, Health and Human Services Building, Room 2210
Reflective surfaces are all around us! If we look carefully, many common objects, e.g., curved mirrors in parking structures, back of a spoon, present distorted reflections of the world, and this distortion is not necessarily undesirable! We will talk about 3D reconstruction from distortion, problem of map making, and about creating images with curved mirrors that conform to the demands of the designer.

M. Leigh Lunsford, Longwood University
Slip Sliding Away
3:05 PM, Health and Human Services Building, Room 2204
Recently I have noticed my students in precalculus and calculus using a "new" technique to factor a quadratic polynomial. This method, called the "slip" or "slide and divide" method appears to be gaining in popularity. In this talk we will describe the method (google "slide and divide" if you want to see it), why it works, and whether it is generalizable. We will also discuss the merits and demerits of teaching the method. Is it just another slide into the abyss where we are only teaching tricks to our students or is there actually some pedagogical value to it? This talk will be completely understandable to students and faculty who know how to factor.

Kurt Ludwick, Salisbury University
Counting Melodies: A Musical Introduction to Recursion
8:00 AM, Health and Human Services Building, Room 2210
In this talk, I will present a lesson that I have developed for my course on connections between music and mathematics for the liberal arts audience. Much of this course is devoted to the study of various types of counting problems that arise naturally from musical considerations. One such problem is counting the number of distinct rhythms or melodies that can be written under specified restrictions. For example: "How many n-beat rhythms can be written using only quarter notes and half notes?" leads us quickly to "discover" the Fibonacci sequence. Minor variations to this question - e.g., changing allowable note lengths, introducing rests, or allowing multiple pitch classes - motivates us to explore a variety of recurrence relations.

Nagaraj K. Neerchal, University of Maryland, Baltimore County
Raji Baradwaj, University of Maryland, Baltimore County
Michelle Danaher, University of Maryland, Baltimore County
Liz Stanwyck, University of Maryland, Baltimore County
Matthias K. Gobbert, University of Maryland, Baltimore County
The Math Gym: To Be on Top of Your Game, You Have to Work Out!
8:00 AM, Health and Human Services Building, Room 2202
The Math Gym is a concept rather than an actual place. Established with the seed money from the Hrabowski Innovation Fund, it applies the wisdom that practice is the key to learning math well. The Math Gym provides a framework of connecting the practice to class work in a tangible way. The Math Gym features "conditioning coaches" and "personal trainers" to help students keep their foundational math skills in good working order. Moreover, the gym

promotes healthy math habits among all our students, drawing a clear analogy between the regular work outs and conditioning needed to maintain both athletic and mathematical skill. Students are recruited into working out in Math Gym based on their performance in QuizZero, a battery of questions designed by instructors of each foundations course. A personalized workout plan is generated for each student based on their responses to questions in QuizZero. The data on attendance reveals interesting patterns of students' use of Math Gym. Impact of Math Gym on students' performance is analyzed using both the current cohorts and historical control.

Edwin O'Shea, James Madison University
Divisibility Unified: A Common Method for Divisibility Tests
9:15 AM, Health and Human Services Building, Room 2210
Suppose you want to test if 39 divides 6435. We claim that you can simply "trim" 6435 to 643+4(5) = 663 and, trimming again, 66+4(3) = 78; since 78 is easily seen to be divisible by 39 then so is the original number 6435. We generalize this trimming method to present one coherent way of generating divisibility tests for all integers, armed only with the most basic of divisibility properties and without the binomial theorem or modular arithmetic. We can also "sum the trimmings" with 6(1)+4(4)+3(16)+5(64) = 390 also being a test for 39 dividing 6435. The well-known sum and alternating sum of digits tests for 9 and 11 follow as corollaries.

Minah Oh, James Madison University
Introducing Proofs to Calculus Students
8:50 AM, Health and Human Services Building, Room 2204
In this talk, I will talk about how to introduce proofs to Calculus 1 students. To teach Calculus students how to write rigorous mathematical proofs may be painful and sometimes unnecessary. It is surprising, however, how these students can get used to writing proofs when they do so regularly as a group. Throughout the semester, the students worked in groups once a week to prove important results in Calculus following a worksheet which provided instructions on how to prove the result. I will report the progress the students made throughout the semester while the worksheet gradually provided less instructions each week. The worksheets and the students' proofs will be presented. This talk is similar to the one I gave in New Orleans, LA during the 2011 Joint Mathematics Meetings, and it is currently under revision for publication at MAA Note Series.

Trevor Richards, Virginia Tech
On Level Curves of Finite Blaschke Products and Polynomials
2:40 PM, Health and Human Services Building, Room 2209
Let $f: \boldsymbol{D} \to \boldsymbol{D}$ be a finite Blaschke product. Then f is analytic on the closure of the unit disk, and both $|f| = 1$ and $f' \neq 0$ on the boundary of the unit disk (these facts are enough to characterize the finite Blaschke products). Then we may say quite a bit about the level curves of f in **D**, that is, the sets $\{z \in G : |f(z)| = \epsilon\}$. We use analysis of these level curves to prove the Gauss-Lucas theorem, that the critical points of a polynomial $p(z)$ are contained in the convex hull of the zeros of $p(z)$.

Bob Sachs, George Mason University
Similarities in a First Differential Equations Course
9:15 AM, Health and Human Services Building, Room 2204
A first course in differential equations often seems like a string of recipes with little motivation for various techniques. Underneath lies a basic notion for linear differential operators, namely similarity (aka conjugation) and related factorizations and shifts. Among the mysteries resolved: double roots, variation of parameters, reduction of order, method of undetermined coefficients, and operator factorizations.

Karin Saoub, Roanoke College
Dynamic Storage Allocation using Tolerance Graphs
9:15 AM, Health and Human Services Building, Room 2209

Dynamic Storage Allocation is a problem concerned with storing items, such as processes in a computer's memory, that each have weight and time restrictions. Approximate algorithms have been constructed through online coloring of interval graphs. We present a generalization that uses online coloring of tolerance graphs and utilizes online algorithms in which the corresponding tolerance representation of a vertex is also presented. We apply the results on the online-with-representation chromatic number of various classes of tolerance graphs to a generalization of Dynamic Storage Allocation, giving us a polynomial time approximation algorithm with linear performance ratio.

Bonita Saunders, National Institute of Standards & Technology
WebGL: Interactive 3D Graphics on the Web without a Plugin
3:05 PM, Health and Human Services Building, Room 2202
There are over 200 interactive 3D visualizations of high level mathematical functions in the NIST Digital Library of Mathematical Functions launched in April 2010. Until recently, users had to download a special viewer plugin in order to see the dynamic 3D graphs. We have now converted all the graphics files to a format called WebGL which permits the rendering of 3D graphics in a web browser without the use of a plugin. The new visualizations are more vibrant and the controls are easier and more intuitive to use. We will talk about the conversion to the new format and show a demo of the updated site.

Hamid Semiyari, James Madison University
A Solution to Boundary Value Problems and Volterra Integral Equations with Parker and Sochacki Method
2:40 PM, Health and Human Services Building, Room 2202
G. Edgar Parker and James Sochacki, of James Madison University (JMU) developed a method based on Picard's iteration method to solve ordinary differential equations (ODEs). The method is an algorithm that generates Maclaurin series solutions to Initial Value Problems (IVPs). The method converts an IVP into a system of first order ODEs, where the right hand side is a polynomial. The advantage of this method is that the method requires only addition and multiplication which makes it a good choice for computation. We demonstrate this method for Two Point Boundary Value Problems (ODE) and Volterra Integral Equations.

Amy Shell-Gellasch, Montgomery College
Ancient Indian Verse and the Powers of 2
2:15 PM, Health and Human Services Building, Room 2204
Ancient Indian culture regarded the writing of verse as a high art. In fact, even their mathematics was written in verse. An important component of writing verse was Prosody, determining which and how many syllables are stressed in each line of poetry. Ancient Indian's used an ingenious mathematical algorithm to determine how many syllables could be stressed. Given that they did not have exponential notation, their method is more efficient than straight multiplication.

Don Spickler, Salisbury University
Using Classical Cryptography and Cryptanalysis as an Enrichment Exercise in a First Course in Linear Algebra
2:40 PM, Health and Human Services Building, Room 2210
The Hill cipher is a block cipher that was developed by Lester Hill in 1929. Although it does not seem to have been used much at the time and by today's standards is not a secure cryptographic system it does provide a very nice application of matrix arithmetic, inversion, and the properties of linear transformations. Furthermore, it is accessible to beginning mathematics students and extends the classroom material, usually done over the real number system, to the modular case in a natural and concrete way. In this talk we will go through an enrichment exercise on the Hill cipher that is suitable for a beginning course in linear algebra. The calculations will be facilitated by the software package Linear ME (Maxima Edition), a linear algebra exploration tool developed by faculty and students at Salisbury University.

Liz Stanwyck, University of Maryland, Baltimore County
Matthias K. Gobbert, University of Maryland, Baltimore County
Raji Baradwaj, University of Maryland, Baltimore County
iPads: In and Out of the Classroom

9:15 AM, Health and Human Services Building, Room 2202

Evolving technology changes the way we teach, and extends the reach of lecture. While teaching Mathematics and Statistics is well-suited to traditional chalkboard presentations, adopting new technology can offer great opportunities for students (and professors). In this talk, I share my journey from chalkboard to laptop to document camera to iPad as a teaching tool. I will discuss the impact of using this technology in the classroom from my point of view and share student feedback for different levels of classes, from the 100-level general education lecture-hall course through a relatively small upper-level course for majors. In particular, I will emphasize the use of tablets to extend the lecture to reach outside of the classroom, leaving more face-to-face time for the skills-building activities essential to learning Mathematics and Statistics. Apps will be demonstrated, and I will share my successes and challenges through the process of adopting the new technology. Discussion, suggestions, and feedback are welcome!

Eve Torrence, Randolph-Macon College

Making Sunshine: A First Geometric Sculpture

8:25 AM, Health and Human Services Building, Room 2210

I recently completed a large sculpture for the Copley Science Center at Randolph-Macon College. The sculpture now hangs from the ceiling in the 2 story entryway. The structure is five intersecting tetrahedra and was inspired by Tom Hull's popular modular origami model of this polyhedron. It is made of powder coated aluminum and is 5 feet in diameter. I will explain the geometry of the piece, the logistics of making such a structure, and the highs and lows of attempting this feat with absolutely no previous experience.

Dina Yagodich, Frederick Community College

Chaos and the Chua Circuit

3:05 AM, Health and Human Services Building, Room 2209

The Chua circuit uses Electrical Engineering techniques to demonstrate the mathematical phenomena of chaos and bifurcations. The circuit models a system of differential equations with nonlinearity resulting in the chaotic behavior. The Chua Circuit is a simple circuit containing off-the-shelf components including resistors, capacitors, an inductor and Op Amps. The mathematical background, MATLAB simulations, as well as a working circuit will be presented.

Godfred Yamoah, Norfolk State University

A Mass Conservatives Scheme for Adaptive Simulation: The L^2 Projection Approach

8:00 AM, Health and Human Services Building, Room 2209

Groundwater flow problems are often characterized by rapid changes in certain regions of the domain. Both finite element and finite difference schemes that adjust the spatial discretization as the simulation progresses are known to improve the accuracy of the solution without greatly increasing the computational costs of the simulations. Spatial adaption (moving grid) involves refining and coarsening the spatial mesh or grid based on error estimates. However, significant mass-balance errors can be introduced if care is not taken during the coarsening phase of the adaption process. In particular, when two elements or cells are merged, nodal information must be re-distributed to preserve the mass of water in the newly merged element. In this work, we consider a Galerkin finite element approach of the model equation. Linear simplex elements are used in space with backward Euler in time. Our spatial adaption involves dividing and merging elements based on the bisection approach. To advance in time, information across the entire mesh is needed from the previous time step. We propose an algorithm to preserve mass during the coarsening process and provide results on a one dimensional infiltration problem that has been well studied in the literature. The method is based on the L^2 projection approach and seeks to redistribute mass on coarsened elements using solution values from the previous time step.

Student Abstracts by Author

Samantha Alpert (Senior), Virginia Military Institute
Rochelle McDaniel (Senior), Virginia Military Institute
Ryan Harner (Senior), Virginia Military Institute
Improving Traffic Safety and Efficiency

2:15 PM, Health and Human Services Building, Room 2208
Traffic is defined in the dictionary as "the amount of people who pass through a certain place or travel in a certain way." As we look into the traffic on the highways of the United States, we use this definition to improve its safety and efficiency. To best accomplish this task, we develop a model that can be used by engineers to predict the number of accidents they would have under specified conditions in a certain amount of time. This model addressed many different variables and factors that can be manipulated based on local statistics. Our current results, based on example statistics, show that human judgment typically is the cause of accidents, not the rules of the road.

Maria Annone (Sophomore), James Madison University
Weighing on Scales Uniquely: MacMahon's Perfect Partitions and their Generalizations
8:00 AM, Health and Human Services Building, Room 2207
Given a two pan scale with one pan strictly for lead weights, one can uniquely measure any integer weight of no more than 15 ounces on the first pan by placing combinations of the set of ounce weights of 1,2,4 and 8 on the other pan. In the late 19th century, writing this set of weights as the partition 1+2+4+8, MacMahon called such partitions perfect. Justifying the moniker "perfect," MacMahon's main result was that perfect partitions of any positive integer n are in correspondence with the ordered factorizations of n+1. Despite this beautiful result of MacMahon, few generalizations of these partitions are known. We manipulate the properties of MacMahon's perfect partitions by allowing an error within one integer when weighing integral weights and call these error correcting perfect partitions. We generalize the results that follow.

Daniel Carroll (Senior), St. Mary's College of Maryland
Maps and Mirrors: The History and Future of Global Selfies
3:05 PM, Health and Human Services Building, Room 2207
The map maker's problem is to choose which geographic and geometric data their map will reflect and which it will distort. We investigate extensions of mirror-design problems inspired by classical map projections. In particular, we study the distortive properties of various mirrors used for catadioptric sensors.

Junru Chen (Senior), Virginia Military Institute
Alexander Falcetti (Senior), Virginia Military Institute
Kristopher Wright (Senior), Virginia Military Institute
Make the Choice
8:25 AM, Health and Human Services Building, Room 2208
Our mathematical model is based on the scenario that Sports Illustrated is in search of a strategy to determine the best college coach, male or female. We select the top ten candidates from basic statistics and achievements, and use the Analytical Hierarchy Process (AHP), which takes a set of criteria based on specific traits to determine the best coach. We choose the traits to determine the best coach to be win percentage, achievements, and changes made. The AHP then generates a weight for each evaluation criteria and assigns a score to each option. After that, AHP combines the criteria weights and the options scores to determine the final score for each option. Each final score reflects the rank for each option and helps us determine the best option with respect to our problem. We apply our model to college football, men's basketball, and women's basketball, and we are able to determine the five best coaches of all time for each of these three sports. This model also can be applied to similar problems that use a set of criteria to determine the best candidate.

Heather Cook (Senior), Roanoke College
Assessment of Water Quality in the Chesapeake Bay by Parameter Estimation
2:15 PM, Health and Human Services Building, Room 2207
Algal blooms have been on the rise in the past few years within the Chesapeake Bay including its tributaries such as the Lafayette River. These blooms are caused by an abundance of nutrients within the water coming from the waste treatment plants and runoff of fields on which dinoflagellates thrive. Virginia Estuarine and Coastal Observing System (VECOS) has been monitoring, at 15 minute intervals via stationary sondes and via boats variably, levels of chlorophyll

within the Lafayette River. For this talk, we will decide how often the boat measurements are needed based on the distribution of the 15 minute data since we want to be thoughtful about the amount of data points while still obtaining accurate readings.

Joseph Foss (Senior), United States Military Academy
Understand Ultrafilters, Understand Schur's Theorem
8:50 AM, Health and Human Services Building, Room 2207
Looking at a finite partition of the natural numbers, Schur's theorem states there exists a cell of the partition such that x, y, and z are all members of said cell where $z=x+y$. This is an important theoretical result of Ramsey Theory and combinatorics in general. A filter is a set of sets that is closed under finite intersections, closed under supersets, and does not have the empty set as a member. An ultrafilter is a maximal filter. By studying semigroups, namely the set of ultrafilters on the natural numbers, we can produce an algebraic proof of Schur's Theorem.

Jonathan Gerhard (Freshman), James Madison University
Patrick Moran (Freshman), James Madison University
How it's Made: 3D Printed Conformations of Knots through 7 Crossings
9:15 AM, Health and Human Services Building, Room 2203
We will discuss the various computer programs used to construct the knots from the previous talk. Constructing a 3D model that is actually printable can challenging. To 3D print the knot conformations through 7 crossings, we used a combination of Mathematica, Blender, Tinkercad, Knotplot, SeifertView, and OpenSCAD.

Erika Gerhold (Senior), Salisbury University
The Group of Units of $\mathbf{Z_p[x]/\langle f(x)\rangle}$ ***when*** $\mathbf{f(x)}$ ***is a Reducible Polynomial***
3:30 PM, Health and Human Services Building, Room 2207
Factor rings of the form $\boldsymbol{Z_p/\langle f(x)\rangle}$, with p prime and $f(x)$ irreducible form an algebraic structure of a field, which has a cyclic multiplicative group structure of its non-zero elements. One obvious question is "What happens when $f(x)$ is reducible?" In this case, $\boldsymbol{Z_p/\langle f(x)\rangle}$ is no longer an integral domain, hence it is not a field, and the multiplicative group of units is no longer cyclic. However, this group is still Abelian and hence can be decomposed into a Cartesian product of cyclic groups. In this talk we will derive concise formulas for determining this cyclic group decomposition. Ring structures of this type have recently become of major interest in the field of cryptography. Since the discovery of public key cryptography in the 1970s, cryptography has relied extensively on algebraic number theory, specifically on the properties of rings and fields. Nearly all of today's secure data transmissions, from military secrets to your on-line purchases, use a system whose security is based on number theory. If the quantum computer is realized, many of these commonly used methods will be rendered obsolete. Rings of this type have been proposed to be used in post-quantum cryptography; cryptographic methods that will not succumb to the power of the quantum computer.

Steven Geyer (Senior), Virginia Military Institute
The Best of All Time: Comparing College Sport's Best Coaches
9:15 AM, Health and Human Services Building, Room 2208
In this presentation, we construct a model that ranks the best college coaches within a sport, throughout history. We conclude that current coaches' value must be visible through at least one of the following categories: tenure with school, overall wins, win percentage, postseason wins, or championships. We assume that all coaches desire to be tenured head coaches for their current team, responsible for the entire performance of their team, and try to win every game they play. We reject the assumption that the differences in tiered sports divisions are significant to coach proficiency. After a cutoff number of wins, we take the best ranked coaches of the several valuable traits, and the quantifiable number of those categories. We normalize all statistics to an evenly weighted unit, and sum them into one ranking system. We rate the coaches with the largest sums as the best in their sport. Challenges to our model include accessibility to reliable and consistent data, and dealing with outliers. Our case studies accurately reflect, by fame of the school, the most successful coaches. Our model is effective, simple, and adaptable to the changes of college sports' evaluation.

Ricky Haller (Senior), Virginia Military Institute
Ryan Poffenbarger (Sophomore), Virginia Military Institute
A Mathematical Approach to Determine the Greatest Coach in College Sports
8:00 AM, Health and Human Services Building, Room 2208
Determining the greatest college sports coach of all time is often made by our views and opinions. In our research of this problem, we worked to take a purely mathematical approach. Since the greatest coach of all time included thousands and thousands of coaches we decided to limit the population to just coaches of college baseball, basketball, and football. These three sports have been around the longest and therefore have a large amount of collected statistical data. To determine the greatest coach of all time we used the mathematical program Lindo to optimize the weights of parameters from which we created a linear model. This model was then used to determine that Rod Dedeaux from University of Southern California baseball was the greatest coach of all time.

Gregory Houchins (Junior), James Madison University
Kirill Korsak (Junior), James Madison University
Taylor Meador (Freshman), James Madison University
3D Printed Conformations of Knots through 7 Crossings
8:50 AM, Health and Human Services Building, Room 2203
Knots are embeddings of circles in 3-dimensional space, but they are typically studied in terms of their projections into 2-dimensional space. We can use 3D printing to study knots in a more 3-dimensional way. In this talk we will present 3D printed conformations of knots through seven crossings. Along the way we will discuss various knot types, including stick, Lissajous, lattice, torus, petal, and twist knots.

Emily Hunt (Junior), James Madison University
A Matrix Population Model for Monarch Butterflies
2:15 PM, Health and Human Services Building, Room 2203
The monarch butterfly (Danaus plexippus) exhibits a unique migration phenomenon by leaving Michoacán, Mexico in the spring and traveling as far north as Southern Canada; later generations return to the same location in Mexico the following fall. However, there is concern within the scientific community about the long-term stability of this impressive annual journey. We use periodic population matrices to model the life cycle of the eastern monarch butterfly and find that this unique migration is not currently at risk. We extend the model to predict the impact of inclement weather and to determine the critical components of the monarch butterfly's life cycle to ensure the longevity of the species.

Christopher Johnson (Junior), St. Mary's College of Maryland
Abiola Akaani (Junior), St. Mary's College of Maryland
Seth Baker (Senior), St. Mary's College of Maryland
Who is the All-Time Best Coach in College Sports?
8:50 AM, Health and Human Services Building, Room 2208
This question leaves open the sport, gender, and division rank of the legendary coach in question. And by nature, this is a question whose answer primarily lives in the heart and mind of the sports fan rather than the mathematician. Between deciding what "all-time best" means, and working through the huge number of college sports coaches through the ages, it might seem easy to dismiss this query as quantitatively unapproachable. Some of us, however, are both mathematicians and sports fans. And for those of us who fit this description, this question is not so easily dismissed. We want there to be an answer, a simple way to characterize the quality of coaches, and to rate them from best to worst. Most of all, we want our answer to be one we can explain to our friends. We want a method simple enough for anyone with a basic knowledge of college athletics to understand how we picked who we picked, and why. With this in mind, we present an intentionally-simplistic model to rank coaches based on criteria everyone can understand: how much they've won, how often they've won tournaments, and how much they got better in the long run. We applied our model to such sports as football, basketball, soccer, lacrosse, and ice hockey, examining both men's and women's teams when

possible. In this talk, we will explain how we ranked some of the greatest all time coaches in these sports, and which of these legendary men and women rank the highest.

Lacey Johnson (Senior), James Madison University
K-potent Groebner Bases and Sudoku
2:40 PM, Health and Human Services Building, Room 2207
Sudoku can be described as a system of polynomials which can then be solved using Groebner basis techniques. A Boolean idempotent approach ($x^2 = x$) restricts degree growth of intermediate polynomials, but increases the number of variables. We use a *k*-potent approach ($x^k = x$) allowing each variable to take on k values. The approach restricts degree growth, but minimizes the number of variables. Preliminary results show the k-potent approach produces the fastest results.

Victoria Kelley (Sophomore), James Madison University
A Linear Analysis of a Straight Rod under Tension, both with and without Drag
8:25 AM, Health and Human Services Building, Room 2207
Starting with a straight rod under tension, we are studying the perturbations in twist and bend using the Kirchhoff Rod Model. Additionally, we can include the effects of drag approximated by resisted force theory. Finally, this model can inform us about the response of internal forces compared to external ones. This work has applications to the study of worm locomotion, bacterial flagella, and DNA.

Carson Maki (Junior), Hampden-Sydney College
Timbral Partial Orders
3:30 PM, Health and Human Services Building, Room 2203
We present a partial order model for comparing musical timbres. The model orders timbres with respect to various timbral qualities, such as brightness or warmth. A parameterization scheme for these timbral qualities is introduced, and used to order the timbres of ten orchestral wind instruments with respect to the timbral qualities of brightness and warmth.

Matthew McCarthy (Junior), Christopher Newport University
Interesting Series Involving the Sum of Reciprocals of the Binomial Coefficient
2:40 PM, Health and Human Services Building, Room 2208
We consider a set of infinite series involving the sum of the reciprocals of the binomial coefficients and try to determine their exact values by means of generating functions. Via specification, differentiation and integration of these generating functions, we obtain a wide class of "interesting series" in terms of well-known constants.

Molly McMillen (Senior), Christopher Newport University
Stochastic Simulation of a Collegiate Dining Hall
3:30 PM, Health and Human Services Building, Room 2208
Stochastic simulation is an important tool in the formulation of mathematical models. We created a model to simulate a collegiate cafeteria dining hall using a Markov process. These simulations are designed to help implement policy to help reduce waste and create a more effective dining experience. Using parameters for different people's food preference, we are able to simulate the number of people at each food station over time.

Jon Marino (Senior), Roanoke College
Integer Compositions Applied to the Probability Analysis of Blackjack and Infinite Deck Assumption
3:05 PM, Health and Human Services Building, Room 2208
Composition theory can be used to analyze and enumerate the number of ways a dealer in Blackjack can reach any given point total. The rules of Blackjack provide several restrictions on the number of compositions of a given number. We present a constructive approach to enumerate the number of ways the dealer can reach any point total. Our results

cover all possible cases and also generalize to changes to the rules of Blackjack. Using the infinite deck assumption, we also find the approximate probability that the dealer reaches that point total.

Ryan Sanford (Senior), The Catholic University of America
Nicholas Shields (Senior), The Catholic University of America
A Brief Introduction to Quantum Cryptography
8:00 AM, Health and Human Services Building, Room 2203
Our research investigates both current methods and future directions in cryptography. We will provide a brief survey of classical concepts and methods, including key distribution, RSA and El Gamal protocols, and the underlying discrete log problem, in both cyclic groups and elliptic curves. We then discuss quantum cryptography, describing the formalism of quantum mechanics and the implementation of the BB84 algorithm.

Katie Sipes (Sophomore), James Madison University
How the Worm Wiggles
3:05 PM, Health and Human Services Building, Room 2203
Viscosity is a measurement of a fluid's resistance to the rate of deformation. An example of a liquid with high viscosity is tree sap, or a homogeneous mixture of mud. Both of these liquids run very slowly when acted upon by gravity. In contrast, water has a very low viscosity and flows readily. So how does a liquid's characteristics affect the locomotion of a swimming organism? Do higher viscosities change the dynamics that an organism implements in order to move in a solution? The Reynolds number is defined as the ratio of inertial to viscous forces and is given by $\rho VL/\mu$ where ρ is the fluid density, V is characteristic velocity, L is the characteristic length of the system, and μ is kinematic viscosity. In particular, I am interested in measuring these different scales in a system where the worm C. elegans is swimming in fluids of different viscosities. We will compare these measurements to different modes of locomotion.

Alyssa Stine (Senior), St. Mary's College of Maryland
Comparison of SVD and PCA to Forecast Time-Series Data in the Financial Sector
2:40 PM, Health and Human Services Building, Room 2203
Singular Value Decomposition (SVD) and Principle Component Analysis (PCA) have been widely used to make investment predictions. We set out to determine the conditions such that one would choose to apply PCA over SVD and then under which conditions one would choose SVD over PCA. We also sought clarification of the underlying mathematics. In this talk, we share our findings and show some example stock market predictions. If time allots we will also share our findings when comparing Support Vector Machine methods with the Partial Least Squares method.

Justin Stine (Senior), St. Mary's College of Maryland
Carrie Winterer (Senior), St. Mary's College of Maryland
David Rice (Senior), St. Mary's College of Maryland
Modeling Traffic Flow with Overtaking
8:25 AM, Health and Human Services Building, Room 2203
We will present our idea about how to model a single car as uses the left hand lane rule for overtaking. While considering how this daily occurrence could be modeled, we determined that we could either construct a microscopic model, described by ordinary differential equations, or a macro- scopic model, described by partial differential equations. We took a microscopic view and used a Lagrangian approach to follow the movement of a single car through light traffic, and constructed separate equations for acceleration and deceleration. These equations define the position of a vehicle as it follows movements dictated by our algorithm. This algorithm is from the perspective of one car which continuously checks its proximity to other vehicles. We will discuss the trade-off between safety and efficiency as well as how our model changes depending on the density of traffic.

Zev Woodstock (Sophomore), James Madison University
Acoustic Oddities, JMU's "Squeaky" Quad & Repetition Pitch
9:15 AM, Health and Human Services Building, Room 2207

This presentation will explore several acoustic oddities which result from a phenomenon called "Repetition Pitch." JMU has several examples on campus where this acoustic oddity can be experienced firsthand. This presentation will introduce the audience to these phenomena and explain the basic acoustic principles causing this effect.

Student (Poster) Abstracts by Author

Rebecca Aaron (Sophomore), James Madison University
Multiple Testing in the Context of Genomic Data
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
The main objective of genomic data analysis is to identify genes exhibiting significant differential expression between cell types. The dimension and complexity of gene expression data create challenging data analysis problems. One of the major problem is inflated type I error rate related to multiple testing. In this work, we discuss different techniques for controlling the type I error rate so that false positive findings could be minimized.

Nicolas Acton (Senior), James Madison University
The Coanda Effect and Its Acoustic Applications
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
The Coanda Effect and Its Acoustic Applications Poster Description: The coanda effect has been used, currently, in many different industries to improve the quality of products and how they function, such as its use in Aeronautics to redirect air in order to create lift on an aircraft, how it is used in order to increase tire traction on Formula 1 race cars, and most importantly how it is used by the oil industry to direct oil flares and protect lives and oil assets. However, the scientific community still lacks information on how the coanda effect will change based on certain air-flow parameters and a research lab based at James Madison University is contributing towards that understanding.

Joseph Bishop (Senior), Virginia Military Institute
Stephen States (Senior), Virginia Military Institute
William Lucas (Senior), Virginia Military Institute
College Coaching Legends
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Sports Illustrated, a magazine for sports enthusiasts, is looking for the “best all time college coach” male or female for the previous century. We are tasked to build a mathematical model to choose the best college coach or coaches (past or present) from among either male or female coaches in such sports as college hockey or field hockey, football, baseball or softball, basketball, or soccer. We are also tasked to determine whether the coaching era has an effect on ranking/selection. For example, does coaching in 1913 differ from coaching in 2013? Metrics for assessment must be clearly articulated and our model’s top 5 coaches in each of 3 different sports will be presented. In addition to the problem stated above, we will prepare a 1-2 page article for Sports Illustrated that explains our results and includes a non-technical explanation of our model that sports fans will understand. Our model is a summation equation including six key variables that determine the success of a coach. Our equation produces an overall score that allows us to rank the coaches from first to fifth in their respective sport. Our model is not only mathematically sound, but is consistent and reliable when checking results with outside sources, and still presents a unique solution.

Kyle Brod (Senior), James Madison University
An Introductory Look at Beamforming and Its Applications
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
A poster presentation on the microphone, sound-based experimentation of beamforming and its overall usefulness in acoustics.

Olivia Brundage (Senior), McDaniel College
Deliver Us from EVAL: An Investigation of the Representations of Optimality Theory through Monoids, FSTs, and Semirings
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS

Created to understand the structure of language's phonetic system, Optimality Theory (OT) describes language as the product from the interaction between conflicting constraints. The structure of monoids and rational relations develops a finite state transducer (FST), which wonderfully gives computation power for OT. However, there are some drawbacks for using an FST as we cannot explore the complexity of EVAL. So we must explore other models, such as the violation semiring, which will allow, for future exploration, a greater view in the complexity of EVAL.

Davis Burke (Senior), Virginia Military Institute
Tyler Andrew (Senior), Virginia Military Institute
Ben Travers (Senior), Virginia Military Institute
Modeling Decision-Making Behavior in Discrete-Time Traffic Conditions
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
We address the problem of modeling lane-changing dynamics, specifically as they apply to the rule of "Keep Right, Except to Pass". Our model allows a broad spectrum of analysis due to its ability to determine essential movement, based upon only the rules of the road and an individual car's surroundings. By arranging the constraints of driving strategies as a set of state diagrams, and using the resultant equations to produce logical expressions, we produce a method for analyzing traffic flow. Our model creates a state machine, based upon the binary logic equations mentioned above, to convert the current position of all vehicles along a stretch of road into their future positions, based on an arbitrary time step. This model gives a general description of the characteristics of traffic scenarios, requiring specificity of location to provide more useful information.

John Boccagna Elder (Sophomore), James Madison University
Henri Coanda and the Coanda Effect
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
A poster with a biography of the life of Henri Coanda, a description of his found effect, and some of the many ways in which he applied it.

Garrow Geer (Sophomore), James Madison University
Josiah Lapolla (Sophomore), James Madison University
Topics in Differential Geometry
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
A discussion of topics in differential geometry.

Doug Hendry (Senior), James Madison University
Minimal Surfaces
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Poster on minimal surfaces.

Jeffrey Kopsick (Junior), James Madison University
Wiggling in a 3D Wonderland
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Using the 3D printers in the JMU Maker Lab, we have developed a protocol for printing 3D environments for the study of C. elegans swimming in different geometries and fluids of different viscosities. C. elegans offers an unprecedented middle ground between the macro and microscopic. This project involves experimental and theoretical components as well as techniques in image segmentation and processing. From these techniques, we aim to quantify how significant the role of environment is to the swimming gait of nematodes. If we can quantify a significant difference between an isolated droplet and a droplet within our environment, we will begin to model the worm's fluid mechanics.

Kirill Korsak (Junior), James Madison University
Gregory Houchins (Junior), James Madison University
Gauss-Bonnet Theorem and It's Applications

2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
We will present the Gauss-Bonnet theorem on compact manifolds, a theorem that allows us to describe an area of a surface based on its curvature. Applications of the theorem to areas on spherical surfaces will be presented.

Josiah Lapolla (Sophomore), James Madison University
Garrow Geer (Sophomore), James Madison University
Subjects in Differential Geometry: Parallel Transport
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
A description of parallel transport and it's applications in general relativity as well as differential geometry.

Ezekiel Mihelcic (Junior), James Madison University
The Development of Geodesics: Straight Lines on Curved Surfaces
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
The poster will trace the history and mathematical development of generalizing the idea of a straight line from Euclidean geometry to the geodesic on curved geometries. It will include a discussion on the naive notion of a geodesic as a curve which minimizes the distance between two points on a curved surface and how this notion failed for certain surfaces, leading to the development of the geodesic as a curve which has a second derivative of zero in the tangent space of the surface. A derivation of the generalized geodesic equations will be presented, followed by the construction of arbitrary geodesics on a few surfaces, accompanied by computer generated images of these curves on their respective surfaces. Connections between the problem of elliptic integrals and the geodesic equations will also be explored.

Joseph Miller (Junior), James Madison University
Test Corrections as an Educational Tool
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Tests are not only a great assessment tool of students' knowledge, but can also be a great educational teaching method. By allowing students to correct their exams for partial credit, instead of just curving the exam and not learning what missed, students are given a second chance to learn from their mistakes and rewarded for it. We found that test corrections improved significantly the conceptual understanding of the material. Our finding is based on statistical evaluations of the percentage increase in scores. In particular, for both tests used in the study, the increase is divided into two components, procedural and conceptual. The basic analysis are done using the scores of two tests from three Integrated Science and Technology courses at JMU.

Patrick Moran (Freshman), James Madison University
Jonathan Gerhard (Freshman), James Madison University
Greg Houchins (Junior), James Madison University
Kirill Korsak (Junior), James Madison University
Taylor Meador (Freshman), James Madison University
3D-Printed Conformations of Knots though 7 Crossings
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Knots are embeddings of circles in 3-dimensional space, but they are typically studied in terms of their projections into 2-dimensional space. We can use 3D-printing to study knots in a more 3-dimensional way. In this talk we will present 3D-printed conformations of knots through seven crossings. Along the way we will discuss various knot types, including stick, Lissajous, lattice, torus, petal, and twist knots. We will also discuss the use of a combination of Mathematica, Blender, Tinkercad, Knotplot, SeifertView, and OpenSCAD to 3D print the knots.

Jeffrey Kopsick (Junior), James Madison University
Wiggling in a 3D Wonderland
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Using the 3D printers in the JMU Maker Lab, we have developed a protocol for printing 3D environments for the study of C. elegans swimming in different geometries and fluids of different viscosities. C. elegans offers an unprecedented

middle ground between the macro and microscopic. This project involves experimental and theoretical components as well as techniques in image segmentation and processing. From these techniques, we aim to quantify how significant the role of environment is to the swimming gait of nematodes. If we can quantify a significant difference between an isolated droplet and a droplet within our environment, we will begin to model the worm's fluid mechanics.

Nada Mukhtar (Sophomore), Baltimore City Community College
Exploring the Mandelbrot Set
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
A friendly introduction to fractal geometry and to the definition of the Mandelbrot set, using recursion in the complex plane. Some illustrative calculations are featured.

Cassandra Poole (Junior), James Madison University
A Research Project on Women in Science, Technology, Engineering, and Mathematics
2:10 PM – 3:30 PM, Second Floor Hallway between HHS and ISAT/CS
Have you ever looked around in a science, technology, engineering, or mathematics classroom? Do you notice a difference between the number of males and the number of females in the classroom? Based on recent survey data, we explore students' perceptions of this difference and discuss teaching strategies to help avoid this difference.