THIS CALENDAR lists meetings of the Society which have been approved by the Council at which papers may be presented. Programs of Annual Meetings appear in the Notices and on the AMS website; programs for sectional meetings appear on the AMS Web pages in the Meetings & Conferences section, and are electronically archived in the Notices section on the AMS website.

MEETING #	DATE	PLACE	ABSTRACT DEADLINE	ABSTRACT ISSUE
976	May 3{5, 2002	Montr¶eal, Qu¶ebec, Canada	March 12	Vol. 23, No. 3
977	June 12{16, 2002	Pisa, Italy	Expired	None
978	June 20{22, 2002	Portland, Oregon	Expired	Vol. 23, No. 3
979	October 5{6, 2002	Boston, Massachusetts	August 13	Vol. 23, No. 4
980	October 12{13, 2002	Madison, Wisconsin	August 20	Vol. 23, No. 4
981	October 26{27, 2002	Salt Lake City, Utah	September 4	Vol. 23, No. 4
982	November 9{10, 2002	Orlando, Florida	September 17	Vol. 23, No. 4
983	January 15{18, 2003 (109th Annual Meeting	Baltimore, Maryland	October 1	Vol. 24, No. 1

Abstracts of the 5002nd Meeting.

The presenter of each talk is indicated by an asterisk (*) in the abstract.

5002-A0-3 Laszlo Lovasz* (lovasz@microsoft.com), Microsoft Research, One Microsoft Way, Redmond, WA 98052. Graphs, Eigenvalues, and Geometric Representations Part I: Graphs and Eigenvalues.

A graph can be described by its adjacency matrix. This simple connection between graph theory and linear algebra becomes much deeper when we discover that purely graph-theoretic properties of graphs and purely linear algebraic properties of the matrix (like its eigenvalues) are closely connected. (Received April 30, 2002)

5002-A0-4 Laszlo Lovasz* (lovasz@microsoft.com), Microsoft Research, One Microsoft Way, Redmond, WA 98052. Graphs, Eigenvalues, and Geometric Representations Part II: Geometric representations of graphs.

There is a third unexpected connection between eigenvalues and geometric representations: adjacency matrices lead to embeddings of graphs in Euclidean spaces, re°ecting graph theoretic properties. For example, for planar graphs, this method gives representations as polytopes, and all polytopal representations can be obtained this way. (Received April 30, 2002)

5002-A0-5 Laszlo Lovasz* (lovasz@microsoft.com), Microsoft Research, One Microsoft Way, Redmond, WA 98052. Graphs, Eigenvalues, and Geometric Representations Part III: Eigenvalues and geometric representations.

Various geometric representations of graphs have been studied and used in a variety of ways: for example, planar graphs can be represented by convex polyhedra. Other representations (like orthogonal representations) have applications to graph algorithms that test properties of graphs which have nothing to do with geometry. (Received April 30, 2002)

5002-A0-132 Colin Adams*, Williams College. \Blown away: What knot to do when sailing" by Sir Randolph \Skipper" Bacon III.

Being a tale of adventure on the high seas involving great risk to the tale teller, and how an understanding of the mathematical theory of knots saved his bacon. (Received June 05, 2002)

5002-A0-133 Alan Edelman*, Massachusetts Institute of Technology. Why are random matrices cool? Come and ¯nd out. (Received June 05, 2002)

5002-A0-134 Catherine Goldstein*, CNRS-University of Paris Sud. Fermat's arthmetic in seventeenth-century context.

Several enigmas surround the life and work of Pierre Fermat. Presented as a typical problem-solver by some, he is considered by others to be the founder of modern number theory. He is supposed to have had a disdain for proofs, but is best known for having claimed one. He was an amateur, but one who seemed at ease with all the mathematical issues of his time. Focusing on arithmetic, the talk will explain how a contextualization of Fermat's work within the mathematical craft and scienti¯c milieu of his time can resolve these apparent paradoxes. (Received June 05, 2002)

5002-A0-135 Jim Lewis*, University of Nebraska at Lincoln. The mathematics education of teachers.

One year ago, the Conference Board of the Mathematical Sciences (CBMS) released The Mathematical Education of Teachers. This report is the mathematics community's response to a series of reports that call for improving mathematics education in our K-12 schools and which argue that investing in good teachers is the key step in improving K-12 education in America. Are we making progress in the struggle to improve the mathematical education of teachers? We will consider this question from both a national and local point of view. (Received June 05, 2002)

5002-A0-136 Robin Lock*, St. Lawrence University. Fun and games for teaching statistics.

How can we capture the attention of students who thrive on video games and competitive sports? Perhaps by introducing a bit of gaming and competition into our regular classroom routines. While we can't expect to match the fascination of a sophisticated electronic game or the excitement of the conference playo®s, we might liven up a daily class hour and sneak in some important statistical ideas along the way. We describe several games and competitive activities that can be used to stimulate interest and help students understand concepts such as correlation, con¯dence intervals, least squares lines, properties of estimators and experimental design. (Received June 05, 2002)

5002-A0-137 **Isom Herron***, Rensselaer Polytechnic Institute. *Random walk, di®usion, and energy decay.*

Random walk, a discrete process, has a striking connection to Brownian motion which is governed in the continuous limit by the di®usion equation. The energy is one property of a solution to this equation. The energy rate of decay will be examined as a means of characterizing solutions to the equation. The methods employed have important applications in continuum mechanics. (Received June 05, 2002)

5002-A0-138 **Frank Morgan***, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. *Soap bubbles: Open problems.*

Despite much recent progress by many mathematicians, including undergraduates, many simple open problems remain. This presentation will also include a little context with demonstrations, explanations, and prizes. No prerequesites. (Received June 05, 2002)

5002-A0-139 **Annie Selden***, Tennessee Technical University. *Two research traditions separated by a common subject: Mathematics and mathematics education.*

\There are no proofs in mathematics education." While this is true, claims are made in mathematics education research and evidence is provided for them. In this talk, I will explore the nature of such research, the kinds of claims and evidence, and what such research might have to o®er teachers of mathematics, especially at the undergraduate level. Along the way, I will point out di®erences between the ways research is done in the two ¯elds. (Received June 05, 2002)

5002-A1-20 **Michael R. Huber*** (michael-huber@usma.edu), Department of Mathematical Sciences, United States Military Academy, Thayer Hall Room 223, West Point, New York 10996. *Getting SMART About Technology in the Calculus Classroom.* Preliminary report.

At the United States Military Academy, one of our goals is to develop students into critical thinkers and competent problem solvers. We have been using the SMART Board, an interactive whiteboard, for the past year in our mathematics classrooms, in both the core and the electives courses. This talk will o®er several examples of real world problems (such as modeling pollution in a reservoir with di®erential equations, solving related rates and optimization problems in di®erential calculus, physics applications of integral calculus) and show how the SMART Board is used to link Internet sites, computer algebra system output (such as Mathematica and Maple), and course web pages to enhance student learning. Students can concentrate on problem solving in the classroom and re-read course notes any time outside of the classroom, in any order (looking at all notes, reviewing a page of notes from the end of class, etc.). At USMA, we have students work in groups almost every day, solving problems on the SMART Board. They then don't have to waste time in class copying down solutions, as the solutions will be available after class. This allows us to work more problems. Student feedback from SMART Board use will be presented, as well as instructor feedback. (Received May 17, 2002)

5002-A1-25 **Peter Gavin LaRose*** (glarose@umich.edu), Department of Mathematics, the University of Michigan, East Hall, 525 E. University, Ann Arbor, MI 48109-1109, and **Robert Megginson** (meggin@math.lsa.umich.edu), Department of Mathematics, the University of Michigan, East Hall, 525 E. University, Ann Arbor, MI 48109-1109. *Implementation and Assessment of On-line Gateway Testing.*

Gateway tests provide a means of assuring that students in reformed precalculus and calculus courses acquire the algebraic and computational skills needed in courses following these, while allowing the focus of the course to be on the conceptual understanding of material intrinsic to the reformed courses. However, logistical di±culties plague the pencil-and-paper administration of these tests, signi¯cantly decreasing their usefulness. To address these di±culties we have implemented an on-line version of these tests which allows students to practice the skills on their own and take the test for a grade in a proctored environment. We report on the details of our implementation and assessment of the system, including our administration procedures and lab use. Our assessment included evaluation of students' perceptions of the e®ectiveness of the program and their actual skill acquisition, and show that the on-line gateway testing is successful in developing students' skills. (Received May 20, 2002)

5002-A1-28 **Bart D. Stewart*** (ab8146@usma.edu), 3078 B Webb Place, West Point, NY 10996. Don't Know Java? You Can Still Excel: On Building Complete Interactive Environments. Preliminary report.

With modern advances, technology continues to weave itself within our classrooms. These technological advances, while certainly able to enhance a student's ability to learn objectives and concepts, come with an associated cost - specifically, the responsibility of learning some non-user friendly computer software. In an effort to reduce the software learning curve, it is possible to create a totally interactive environment that rivals some popular Java Applets in mere minutes using nothing more than Microsoft Office.

Why an interactive environment? Dynamic environments promote opportunity for self-exploration and discovery. The exploration fosters a deeper understanding of material rather than simply resting on the periphery.

In practice, these simple-to-make environments have proven more than worthwhile. With the "point and click" technology, my students were able to investigate a myriad of Discrete Dynamical System behaviors, both linear and nonlinear, through observing the effect of varying parameters in a numerical and graphical fashion simultaneously. Creating this type of environment not only added new dimension to my students' focus, creativity, and willingness to explore, but it also presented an easy, adaptable tool for all of us. (Received May 21, 2002)

5002-A1-70 **Carol G. Crawford*** (cgc@usna.edu), Mathematics Department, U.S. Naval Academy, 572 Holloway Road, Annapolis, MD 21402. Interactive Web Based Labs for the U.S. Naval Academy - Real World Applications Designed with Java for the 3-semester Calculus Sequence.

The author presents a package of interactive, web-based calculus labs designed for the 3-semester calculus sequence at The United States Naval Academy. Joint work with Mark Meyerson, the author developed these modules over a two-year period as a curriculum project sponsored by the Academy. The authors first presented these labs at the 1999 AMS-MAA National Meetings in Washington, DC.

These labs were designed using Java applets and the web. Nine" labs" were produced, each one containing a Java language applet that simulated some real world (military or industrial) application of calculus. The applets are interactive, allowing the user to experiment with adjusting parameters to see how that affects the results. Each lab consists of the interactive applet, a self-quiz, a math review and additional applications.

The author will present how these labs are currently being integrated into the 3-semester calculus curriculum at the U.S. Academy. The discussion will also include comments on how these labs can be linked to as part of an "electronic syllabus" in calculus with links to multiple sources for the student. Anyone on the web can experience these labs at:http://mathweb.mathsci.usna.edu/faculty/meyersonmd/labs/index.html (Received May 30, 2002)

5002-A1-71 **Michelle M. McCassey*** (am5410@usma.edu), Thayer Hall, Rm 227B, 646 Swift Road, United States Military Academy, West Point, NY 10996, and **Alex J. Heidenberg** (aa5178@usma.edu), Thayer Hall, Rm 225, 646 Swift Road, United States Military Academy, West Point, NY 10996. Integration Of Laptops Into The Classroom At USMA. Preliminary report.

Portable Notebook Computers provide an even greater technological resource that facilitates the need to once again reexamine our goals for education. Storage and organization coupled with powerful graphical, analytical, and numerical capabilities allow students to enhance their learning. Beginning with the Class of 2006, cadets at USMA will be issued laptop computers rather than desktops. This transition to laptops has generated changes in the way USMA thinks about the teaching and assessment of learning in mathematics. A pilot course in the Spring 2002 term experimented with the use laptops in the classroom. The pilot class introduced discrete calculus concepts in preparation for the Fall 2002 term when 1000 new cadets will take the same course. This talk will introduce some of the changes made thus far to incorporate notebook computers. We will conduct a demonstration of several creative exercises that allow the student exposure to mathematical modeling concepts with the ability to explore how they may determine patterns and connections which facilitate the process of constructive understanding. Additionally, since it is well known that what we test is what students learn, we will provide insight into how our methods of assessment will adapt to the changes in technology. (Received May 30, 2002)

5002-A1-84 Clark P. Wells* (wellsc@gvsu.edu), 2267 Mackinac Hall, Grand Valley State University, 1 Campus Drive, Allendale, MI, 49401. The Mathematics of Move: Using Maple and Netscape to Solve Linear Algebraic Problems in Chemistry Web Page Design. Preliminary report.

The shape of a molecule plays a large role in its chemical activity, so understanding the geometry of a molecule is very important. In chemistry, just as in mathematics, discovery helps students \own" knowledge. When a colleague from chemistry approached me with a problem involving manipulating models of molecules via the Web, I saw an opportunity to combine discovery in both chemistry and mathematics.

MDL Software's Chime plug-in for Netscape allows the user to manipulate a molecular model, an almost \hands-on" experience. The problem was to ¯nd a way to provide a student with a \hint" | moving the molecule from its current position to a prede¯ned position. The di± culties were that Chime:

1. only accepts instructions to rotate in the form of rotations about coordinate axes in ¯xed order,
2. reports positions in the opposite order of that needed, and
3. animates rotations by assuming that composition of rotations is commutative.

Not only are the problems less trivial than they appear at ¯rst, but the connection to chemistry and computers provide an applied setting for some important points arising in the study of linear transformations, eigenvectors, and eigenvalues. (Received June 03, 2002)

5002-A1-100 Timothy D. Comar* (tcomar@ben.edu), Department of Mathematics, Benedictine University, 5700 College Road, Lisle, IL 60532. Visualization of Mbius Transformations in Two and Three Dimensions Using a CAS.

We present several computer algebra activities that are designed to help students develop a visual understanding of the beautiful geometry of Mbius transformations in the complex plane and in the upper-halfspace model of three-dimensional hyperbolic space. Our techniques depend heavily on applying basic analytic geometry and the graphing capabilities of a computer algebra system. These explorations address several important issues for students including the appropriate and e®ectively usage of a computer algebra system to visualize geometric phenomena and the recognition of the interplay between algebraic representations and geometric renderings. The culminating explorations can be used as part of capstone experiences, which bring together notions from complex variables, geometry, algebra and topology. (Received June 03, 2002)

5002-A1-101 Karen L. Shuman* (kshuman@math.uiuc.edu), Department of Mathematics, University of Illinois at Urbana-Champaign, 1409 W. Green Street, Urbana, IL 61801. An anonymous web-based question form for beginning actuarial statistics students. Preliminary report.

Students in the spring 2002 actuarial statistics course at the University of Illinois Urbana-Champaign submitted questions anonymously over the web with a cgi script. The instructor posted the questions with answers on the class web page. Students were surveyed mid-term about their use of the form and their reactions were positive. We will discuss the types of questions asked, the frequency with which the form was used, and the way the form changed the way the instructor interacted with the students. (Received June 03, 2002)

5002-A1-103 Sean L. Forman* (sforman@sju.edu), Dept. Math and Computer Science, Saint Joseph's University, 5600 City Ave, Philadelphia PA 19119. On-line Educational Generation of TSP-instances. Preliminary report.

Hamiltonian Circuits and by extension the Traveling Salesman Problem (TSP) are often covered as part of Graph Theory sections in Contemporary Mathematics courses. TSP requires the determination of the shortest circuit (a tour that begins and ends in the same city) connecting a given set of cities. Typically, the students are introduced to the TSP and shown several common heuristics that can be used to ¯nd an approximate (sometimes optimal) solution.

This paper describes a web application, TSP Generator, that takes as an input a list of user-provided cities (up to 30), and produces a variety of outputs useful to an instructor or student covering this subject. A description of how this application has been used in Saint Joseph's Topics in Contemporary Mathematics course will be given as well.

TSP Generator will produce the city-to-city distance matrix, will ¯nd approximate solutions using two common heuristics, the Cheapest Link Algorithm and the Repetitive Nearest Neighbor Algorithm, and in some cases, will ¯nd the optimal circuit among all possible circuits. Finally, a map of the inputted cities is displayed. http://www.sju.edu/~sforman/research/
usa_tsp.html (Received June 03, 2002)

5002-A1-125 Maura B Mast* (maura.mast@umb.edu), Department of Mathematics, University of Massachusetts Boston, Boston, MA 02125-3393. Using technology in a Quantitative Reasoning Course. Preliminary report.

In this talk, I will describe how instructors at the University of Massachusetts Boston use technology in teaching a new course called Quantitative Reasoning. In this course, the stress is on reasoning, rather than on mathematical manipulation and computation. Students learn how to use the algebraic and technological tools employed in the social, physical and life sciences to analyze quantitative information. They study some basic statistics, and explore linear, exponential and quadratic models; they use these tools to analyze real data. This course is taught in a computer lab (use of technology is an explicit part of the course syllabus), and students use Microsoft Excel, Internet browsers, and special course-specific software. The goal, and the challenge, is to use the technology in a meaningful way on a daily basis. I will discuss how we are meeting this goal, and how we are dealing with the challenges. (Received June 04, 2002)

5002-B1-87 B. Lynn Bodner* (bodner@monmouth.edu), Department of Mathematics, Monmouth University, West Long Branch, NJ 07764, and Richard A Kuntz (kuntz@monmouth.edu), Department of Mathematics, Monmouth University, West Long Branch, NJ 07764. A Preliminary Assessment of a Web-based Personalized System of Instruction (PSI) Environment Created for a Pre-Algebra Course.

Since the Fall 2000 semester, the Mathematics department of MU has offered 12 sections of a Pre-Algebra course; 9 of the sections were run in a traditional lecture format, but the remaining 3 used a web-based Personalized System of Instruction (PSI) environment. The PSI system, called MUTester, was developed by Richard Kuntz and is a computerized version of the plan put forth in Good-bye Teacher by Fred Keller in 1968. The MUTester system allows each student to access practice exercises and take tests through Internet Explorer. It also facilitates individual student and class progress-tracking, as well as dynamic problem database maintenance. A more complete description of MUTester was presented at the 2001 MAA meeting in San Antonio by Richard Kuntz and is available on his webpage. This paper will present our preliminary outcome-assessment findings regarding the Pre-Algebra students as they enrolled in successive math courses. We will also demonstrate recent improvements made to MUTester since its inception and discuss our future plans. (Received June 03, 2002)

5002-B1-88 Linda Becerra* (becerral@dt.uh.edu), Department of Mathematics, University of Houston-Downtown, Houston, TX 77058, and Ongard Sirisaengtaksin (ongards@dt.uh.edu), Department of Mathematics, University of Houston-Downtown, Houston, TX 77058. Design and Implementation of E-Learning College Algebra.

We demonstrate an e-learning mathematics application that includes writing, computational and graphical activities. Students may access this application and may also submit their responses to the instructor online. In the application, links to computational and graphical tools are provided as students need them. The application may also include instructor notes and online quizzes. This application is designed and implemented using Microsoft Active Server Pages (ASP) with a database and Java applets. ASP is utilized to create an online laboratory front end that contains instructions, HTML elements, and a scripting code (Received June 03, 2002)

5002-B1-90 P. Manoharan*, University College, University of Maryland, College Park, MD 20742. A Global Classroom on Webtycho platform.

Abstract: University of Maryland University College (UMUC), is a "virtual University" within the University System of Maryland, recognized as a leader in distance education, particularly in courses delivered online via the Internet. Adhering to its mission of bringing convenient and relevant learning opportunities to working adult learners, UMUC has developed more than 300 online courses, making UMUC the largest online university in the country with more than 60,000 online enrollment. In our presentation, we briefly discuss a sample of a web based mathematics course that is currently offered at UMUC. (Received June 03, 2002)

5002-B1-91 Ananda Gunawardena*, Department of Mathematics, Carnegie-Mellon University. A TextCentric communication model for teaching Mathematics.

Communication is a critical element of any learning environment. Ability to communicate effectively and accurately in the context of core content makes learning more enjoyable. Studies have shown that students learn more when content is presented and discussed in an annotated mode. In this talk we will demonstrate a new eLearning system for building learning objects around the core text content and a communication model for exchanging these learning objects with other learners. (Received June 03, 2002)

5002-B1-92 **Pramod Kanwar*** (pkanwar@math.ohiou.edu), Department of Mathematics, Ohio State University. *Experiences in Teaching an online Linear Algebra Course.*

The presenter will share his experiences in teaching a linear algebra course using distance-learning tools. Among other things, the presenter will focus on delivery of course material, using computer algebra systems and other electronic tools in the course, contact with the students, testing options, and strengths and weaknesses of such an approach of teaching. (Received June 03, 2002)

5002-B1-93 **Nkechi Madonna*** (nagwu@bmcc.cuny.edu). *Introductory Statistics: E-distributed Course Development, Teaching and Learning.*

This presentation will share with the audience the presenter's experience in developing and teaching, and in mentoring faculty to develop and teach, two e-distributed statistics courses at the Borough of Manhattan Community College (BMCC), City University of New York (CUNY), within the auspices of the BMCC Title III and Distance Learning Faculty Development Programs. BMCC is a minority-serving two-year urban commuter college with a diverse student population of approximately 16,000 students. Two part-time faculty members are currently being mentored by the presenter to enhance and teach the current courses, and to develop their own e-distributed courses, given that part-time faculty have fewer opportunities to avail themselves of the professional development avenues. The presenter will also share with the audience the impact of this type of mentoring collaboration on the professional growth and development of the presenter and her part-time faculty mentees. (Received June 03, 2002)

5002-B1-95 **James White*** (mathwrig@gte.net), Mathwright. *Introducing Mathwright Microworlds.*

The aim of this talk is to describe a new type of web document that recently made its appearance at the New Mathwright Library and Caf (http://www.mathwright.com) and to discuss it from two perspectives: from the point of view of its readers (students of mathematics), and from the point of view of its prospective authors (teachers of mathematics). (Received June 03, 2002)

5002-B1-96 **Erin M Hodgess*** (hodgesse@uhd.edu), Department of Mathematics, University of Houston-Downtown. *Stats Alive! The Development of an Online Statistics Course.*

We discuss the development and pilot phase of a ¯rst semester Business Statistics course. We consider the positive and negative aspects of this mode of presentation. We elaborate on the grading rubric and the interactive elements of this discipline. Finally, we discuss future plans. (Received June 03, 2002)

5002-C1-15 **M. Elizabeth May¯eld*** (mayfield@hood.edu), Dept. of Mathematics and Computer Science, Hood College, 401 Rosemont Avenue, Frederick, MD 21701. *An internship at the MAA.*

One of my advisees, a senior mathematics major, recently completed an internship at the national o±ce of the MAA in Washington. I will describe the work she did there, the skills needed for this internship, the role of the on-site supervisor and my role as internship advisor, the portfolio the student submitted for her ¯nal grade, and what the student learned on the job. (Received May 15, 2002)

5002-C1-31 **Zsuzsanna M. Kadas*** (zkadas@smcvt.edu), Department of Mathematics, Saint Michael's College, Winooski Park, Colchester, VT 05439. *Independent Study on a Shoestring.*

For over ten years, all mathematics majors at St. Michael's College have been required to take the Senior Seminar. The Seminar meets once a week and provides students with the opportunity to pursue a topic that may not arise in the regular course o®erings, to write an expository research paper, and to present the topic to students and faculty. In this talk we will describe the history of the Senior Seminar, the mechanics of how it runs, the Seminar as a collegial undertaking, and the role of writing and peer assessment. We will contrast the Senior Seminar with other independent learning options at St. Michael's: the Honors Thesis and the Readings and Research course. Examples will be provided as well as an overall assessment of the success of this course for majors. (Received May 21, 2002)

5002-C1-33 Kay B. Somers* (mekbs01@moravian.edu), Department of Mathematics and CS, Moravian College, 1200 Main Street, Bethlehem, PA 18018. An Overview of Recent Field Study Experiences.

This talk will include a description of a variety of field study experiences undertaken by Moravian College students over the past ten years. The field study experience normally takes the place of one course unit and requires that students spend at least ten hours per week throughout the semester working on a project or projects at a local company. Students keep a journal, meet weekly with the College supervisor and give written and oral reports at the end. Various aspects of the field study experience will be discussed, including College requirements, companies' and students' expectations, how to obtain such placements, and guidance given to students. (Received May 22, 2002)

5002-C1-45 Raymond F Tennant* (Raymond.Tennant@zu.ac.ae), Zayed University, P.O. Box 4783, Abu Dhabi, United Arab Emirates. Independent Research Projects for Mathematics Students at Zayed University. Preliminary report.

Zayed University is a modern university for national women in the United Arab Emirates. Each student is required to have a year-long research experience, which includes one semester of independent research directed by a faculty advisor and culminating in a capstone project the following semester. The capstone project is designed to integrate the student's academic experience in the major by focusing on a particular theme, problem, or project and to allow her the opportunity to design and implement a creative, original research study.

In this paper, the author describes experiences directing undergraduates at a university honors program in the U.S. and how this knowledge has been useful in developing undergraduate research projects for mathematics students at Zayed University. Current projects are being designed which connect to the culture of the Arab world. One project views mathematics from the historical perspective of Arab mathematicians. Another project constructs Islamic tilings and ornamentation using straightedge and compass methods along with computer imaging programs. This project also classifies the different types of ornamentation from mosques, palaces, and other buildings in the region. Examples of student projects will be given. (Received May 28, 2002)

5002-C1-49 Kevin W. Dennis*, Saint Mary's University of Minnesota, 700 Terrace Heights, 59, Winona, MN 55987. Senior Seminar. Preliminary report.

At Saint Mary's University of Minnesota, all senior mathematics majors are required to take a 1-credit course entitled "Senior Seminar". The major component of this seminar is an independent learning experience, which students must present orally and in written form. We will address how the course was structured, the role of the instructor and the nature of the students' work. We will also present the rubric used in grading the oral presentations and papers. (Received May 28, 2002)

5002-C1-59 Doreen R. N. De Leon* (ddeleon@math.ucla.edu), Department of Mathematics, University of California, Box 951555, Los Angeles, CA 90095-1555, and John J. Westman (jwestman@math.ucla.edu), Department of Mathematics, University of California, Box 951555, Los Angeles, CA 90095-1555. Introduction to Scientific Research: A Group Approach to Individual Undergraduate Research.

Introduction to Scientific Research is a non-traditional course at UCLA that provides undergraduates with a research experience and is featured in a successful NSF VIGRE grant. The target audience is freshman and sophomore students, and the course requires only a quarter or two of calculus and basic programming skills. Therefore, Maple is used to help explore mathematical models analytically, graphically, and numerically. The format for the class features formal lectures, group discussions, structured computer demonstrations, and brainstorming sessions. This course provides a format in which a number of students can experience research in a more efficient manner than working one-on-one with a faculty member. The goal is student involvement in performing individual research. Students select their own topics for research, which aids in retention and completion of the course, and they are encouraged to find faculty mentors. Innovation is encouraged in student projects. The course is centered around communication skills, developmental knowledge sets, and task sets, using various resources such as LaTeX, Microsoft PowerPoint, and Microsoft Word. The grade for this course is based on completion of the task sets, final presentation, and class participation. (Received May 29, 2002)

5002-C1-62 Matthew J Haines* (haines@augsburg.edu), Augsburg College, 2211 Riverside Ave, Box 28, Mpls, MN 55454. Priming Students to be Thrown into More Independent Learning Experiences.

For schools that do not require independent learning experiences, such experiences can still play a meaningful role in the education of some students. Brief exposures can lead students to more independent learning. Such experiences can occur in various forms: challenge problems in class or a newsletter, competition problems, or independent studies that are student initiated.

This presentation discusses a mini-project which led a student to read about the history of projectile motion. Her motivation was two-fold: 1) she was interested in the history of mathematics and 2) she agreed to be part of a presentation about trebuchets. The trebuchet project was initiated by a colleague who is a medieval historian. He invited a physicist and me to assist in creating an interdisciplinary learning activity. In my presentation I will describe the faculty collaboration, the work carried out by the student, and analyze the potential for such experiences to motivate students to pursue further independent study. (Received May 29, 2002)

5002-C1-72 **John Cohn**, IBM, Essex Junction, VT, **Joanna Ellis-Monaghan***, Department of Mathematics, St. Michael's College, Winooski Park, Colchester, VT 05439, **Dan Nardi**, Department of Computer Science, University of Vermont, Burlington, VT 05405, and **Robert Snapp**, Department of Computer Science, University of Vermont, Burlington, VT 05405. Independent Studies with Industry Partnership. Preliminary report.

Industry applications can provide a rich source of rewarding independent study projects for both undergraduate and graduate students. In this talk, we will share our experience in building a relationship with the local IBM plant and soliciting problems of mutual interest. We will present an example of a current project, developing pattern-recognition software using graph theory techniques. (Received May 30, 2002)

5002-C1-79 **Bruce F Torrence*** (btorrenc@rmc.edu), Dept. of Mathematics, Randolph-Macon College, Ashland, VA 23005. Undergraduate Research - A Model for Success.

At Randolph-Macon, I have directed several successful student research projects. One way to measure success is by outcomes: publications, presentations, and awards.

Because I feel that it is important to give students opportunities to present their results, I require that every project start with the goal of a presentation both at our college and at a regional MAA meeting. This immediately sets in the students' minds a notion of the seriousness with which they are expected to proceed. In practice, it also sets a ¯rm timetable for completing various components of the project, and often leads naturally to the students entering national competitions, and presenting in larger forums. Last year a pair of my students entered and received the \outstanding" designation in COMAP's MathServe competition (one of two in the nation). Our regional MAA section helped send them to Madison to present at last summer's Math Fest. Other projects have led to publications in journals such as Math Horizons and the Pi Mu Epsilon Journal.

In this talk I will discuss how to structure student directed research with these outcomes in mind. (Received June 02, 2002)

5002-C1-89 **Daisy Cox McCoy*** (Daisy.mccoy@lsc.vsc.edu), PO Box 190, Lyndon Center, VT, 05850, and **Patricia LaRose** (patty11512@aol.com), 165 Richardson Rd, Orange, VT, 05641. The Impact of an Independent Learning Experience on a Student and Her Professor.

Faculty usually believe that independent learning experiences are valuable for students. In this talk we will explore some of the ways that a particular independent study impacted the student and the instructor. We will also discuss ways the experience could have been improved and the long term e®ects as the student re°ects on her experiences during the study and her subsequent explorations in mathematics. (Received June 03, 2002)

5002-C1-120 **Lionel Rosen*** (lrosen@lynn.edu), Professor & Chair, Department of Mathematics, College of Arts and Sciences, Lynn University, 3601 North Military Trail, Boca Raton, Florida 33431. Innovation, Cooperation and Experimentation; The Cornerstones of an Honors College Algebra Course for Non-Mathematics Majors.

At Lynn University a new policy has been introduced that requires all undergraduate students to take college algebra. In response to this requirement, the Honors Program has developed a new college algebra course. It covers advanced topics beyond ordinary college algebra and is intended to prepare honors students for calculus and other advanced mathematics courses. It is also intended to encourage students to pursue successful careers in mathematically oriented ¯elds. In this talk I will describe the content of the new honors college algebra course and the roile of ¯eld trips and limited internships in the course. I will also discuss the research component of the course and the role of outside evaluators in helping to determine the grade for the research paper. (Received June 04, 2002)

5002-D1-11 Matt D Lunsford* (mlunsfor@uu.edu), Union University, 1050 UU Drive, Jackson, TN 38305. The Ideas of Evariste Galois: Recovering Motivation in Abstract Algebra.

How can the ideas of Evariste Galois as published in his famous memoir, along with a thorough discussion of the historical perspective of his work, enhance the teaching of undergraduate abstract algebra? This talk will answer that question in two ways. First, the ideas of Galois in his famous paper Memoir on the Conditions for Solvability of Equations by Radicals (published posthumously in 1846) will be discussed. This memoir includes the ¯rst use of the term "group" and the origin of the concept of normal subgroup. Also present in primitive form are the notions of extension ¯elds, splitting ¯elds, polynomial rings, and quotient rings. Secondly, the application of these ideas to the current pedagogy of abstract algebra will be explored. In particular, the talk will focus on the placing major topics in their proper historical context, motivating major topics through the examination of concrete mathematical problems from which they arose, and presenting major topics in an order that respects the origins of the subject matter while meeting the pedagogical needs of the students. To accomplish these goals, the talk will support a "rings-¯elds-groups" approach to a ¯rst course in abstract algebra as opposed to the standard "groups-rings-¯elds" approach. (Received May 14, 2002)

5002-D1-12 Lawrence D'Antonio* (ldant@ramapo.edu), 24 Meadoway, Dobbs Ferry, NY 10522. The Group Law for Elliptic Curves. Preliminary report.

Elliptic curves play a central role in the recent history of mathematics, for example, the proof of Fermat's Last Theorem. This talk will focus on the topic of the addition of rational points on elliptic curves. There is a lovely interaction between algebraic and geometric ideas in this topic. Speci¯cally it gives students a visual example of a group operation, but one that also uses ideas from number theory.

Furthermore, the theory of elliptic curves has a very rich history, for which this talk will try to give an overview. Particular highlights are its origins in the work of Diophantus, the development of the chord and tangent method by Newton, the connection with elliptic integrals in the work of Euler and Jacobi, culminating in the monumental paper of 1901 by Poincare. (Received May 14, 2002)

5002-D1-13 Ron Barnes* (BarnesR@uhd.edu), CMS Department, University of Houston-Downtown, One Main Street, Houston, TX 77002, and Linda Becerra (BecerraL@uhd.edu), CMS Department, University of Houston-Downtown, One Main Street, Houston, TX 77002. New Paradigms for the History of Mathematics Course with an Emphasis on Important Ideas and Individuals of the 20th Century Mathematical and Computer Sciences. Preliminary report.

This talk consists of a brief overview of an earlier paper "Rethinking the History of Mathematics Course" and extends it by giving some new ways of integrating more recent ideas and individuals into the course. Topics considered include: (a) Timelines - of more recent developments with parallel snapshots of 20th century developments in Mathematics and Computer Science; (b) Individuals - brief biographies of important men, women and minorities in Computer Science and Statistics (various resources including books and videos are noted); (c) Ideas and Concepts - earliest developments in CS to quantum computing, various timelines can be developed (history of computer science and statistics texts and other resources are used to highlight important ideas and concepts); (d) Minorities and Women Contributions and Progress in the Profession - various resources including those of AWM are considered. Also, a review of the recent NSF Report on Equal Opportunities in Science and Engineering is discussed. This report covers a number of separate issues ranging from diversity to future projections and concerns. Several examples will be presented from each of these categories, including a number of timelines to illustrate the described paradigm. (Received May 14, 2002)

5002-D1-16 Amy Shell-Gellasch* (aa7423@usma.edu), Department of Mathematical Sciences, West Point, NY 10996. Using the History of Your College and Department to Build a History of Mathematics Course. Preliminary report.

Most students graduate from college with little or know knowledge of the history of the institution of which they so proudly where the sweatshirts. They also learn very little about the department they are studying in and the people they are learning from and what they do. Since no one semester history of mathematics course can come close to covering all topics, some way of focusing the course must be found. To remedy these two issues, this year I will be o®ering a course entitle The History of Mathematics from the West Point Perspective. This course will use the history of: the Academy, the Department of Mathematical Sciences, and the curriculum to motivate the topics covered. I will discuss how the topics are chosen as well as student assignments that merge topics in the history of mathematics with the history of the institution and its faculty. (Received May 15, 2002)

5002-D1-19 Jeff Johannes* (johannes@member.ams.org), Mathematics Department, 1 College Circle, Geneseo, NY 14454-1401. **Modern Geometry.** Preliminary report.

Once we get beyond Euclid and Archimedes most of the geometry and all of the topology we discuss is 19th and 20th century mathematics. The 19th century opens with the birth of algebraic geometry and the rise of nonEuclidean geometry. Differential geometry and axiomatic geometry are also both receiving serious attention. The 20th century features the invention and innovations of topology. In this talk we will survey these developments and weave them through the appearances of visual mathematics in the undergraduate curriculum. (Received May 16, 2002)

5002-D1-38 Alexander F Kleiner* (alexander.kleiner@drake.edu), Mathematics and Computer Science, Drake University, 2507 University, Des Moines, IA 50311. **What is a Point of Inflection? A Preliminary Report.** Preliminary report.

Abstract: A survey of 20th century, English language texts (mostly at the level of freshman calculus) provides a catalog of things we tell our students to avoid. Some authors give a formal definition, others use an example or an informal discussion. Moreover, at least 10 different definitions can be found in these books, sometimes different definitions are implied in the same text. On the other hand, several articles, written over the last century, have shown that these definitions are, in general, not equivalent.

This topic, a basic part of almost every Calculus I class, can be used to show students the importance of precise mathematics and the value of well chosen examples and graphs.

The paper will discuss the spectrum of definitions of point of inflection and provide examples and theorems to show their differences. It will also point to starting places for students who wish to explore the issue themselves. (Received May 23, 2002)

5002-D1-82 William C. Calhoun* (wcalhoun@bloomu.edu), Department of Math., Comp. Sci. and Stats., Bloomsburg University, 400 East Second Street, Bloomsburg, PA 17815-1301. **From Hilbert's Program to Computer Programming.** Preliminary report.

The impact of computers on our lives is obvious to everyone, while mathematical logic is an esoteric subject for most people. Yet the histories of mathematical logic and computers are tightly interwoven. I bring the connections between logic and computing into my Discrete Mathematics and Theory of Computation courses. My students are surprised and interested to learn that work on abstract questions in logic led to ideas that were fruitful in the design of computers.

The path from mathematical logic to computers includes some of the most famous names in 20th century mathematics. We can trace the genesis of "computer code" from Hilbert's formal proof theory, to Gödel's coding of proofs by numbers, to the codes for Turing machines and the instructions for von Neumann's stored program computer.

I have my students give brief presentations in class. In addition to the four mathematicians listed above, students have chosen to speak on Cantor, Kleene, Chomsky and Julia Robinson. The students have found the presentation to be a valuable and enjoyable assignment. They appreciate the "general intellectual interest" of the mathematics and relate to the human challenges faced by these brilliant mathematicians. (Received June 03, 2002)

5002-D1-116 Linda McGuire* (lmcguire@al.muhlberg.edu). **Using Recent History in a Combinatorics and Graph Theory Course.** Preliminary report.

The talk I propose giving would focus on a pedagogical approach that I have implemented in a junior-senior level course in combinatorics and graph theory. Each student in the class was assigned to find out about at least one researcher, mathematician or otherwise, whose work is classified as being in the combinatorics or graph theory realm. The student was then responsible for "introducing" the researcher to the class via an oral presentation/discussion. This presentation would precede the discussion of the course material that related to the work this person had done. After the standard class material was covered, students would need to "wrap up" the session by discussing the current or future work of the researcher in question and any open problems that might be accessible to the class. At the end of the term we compiled a portfolio of the work that the entire class had produced. Students were taken with their roles as historians, setting the stage for the mathematics to come. Many important writing issues regarding reliable hardcopy sources, proper citation techniques, and the integrity of internet sources arose and were addressed. (Received June 04, 2002)

5002-D1-141 Dick Jardine* (rjardine@keene.edu), Keene State College, Assistant Professor of Mathematics, Keene, New Hampshire 03435. Numerical Methods History Projects.

Student projects with a significant historical component can humanize the numerical analysis experience, and such projects are the focus of this presentation. Various computational projects with historical features are described which have been successfully employed to enliven a numerical methods course. Additionally, the history of mathematics is the foundation of a final course project which serves as a course review, and includes the work of such mathematicians from the last 200 years as Runge, Adams, Birkhoff, Richardson, and others. These projects are appropriate for an undergraduate mathematics or computer science course in numerical analysis. (Received June 06, 2002)

5002-E1-23 Kate G. McGivney* (kgmcgi@ship.edu), Mathematics Department, Shippensburg University, Shippensburg, PA 17257. Using Simulations to Solve Expected Value Problems. Preliminary report.

We will look at a variety of interesting probability problems such as the "Hat Check Problem" and the "Chinese Birth Problem" and will explore expected value concepts. In each case we will see how simulations, using technology, can be used to experimentally find a solution. These rich problems can be used in introductory probability and discrete math courses as well as serve as an application to series in calculus. (Received May 20, 2002)

5002-E1-35 Stephanie Fitchett* (sfitchet@fau.edu), Florida Atlantic University, Honors College, 5353 Parkside Drive, Jupiter, FL 33458. Group Theory with a Rubik's Cube. Preliminary report.

The group of permutations of a Rubik's cube, while extremely large, is an interesting and concrete example of a finite group. To solve a Rubik's Cube, most people develop or learn sequences of moves (operators) that do specific things like swapping two edges or twisting two corner pieces in opposite directions. We will discuss how studying subgroups of the cube group can lead to identification of useful operators, and how conjugation of operators can be used as an aid in solving the cube. (Received May 22, 2002)

5002-E1-42 Richard G Laatsch* (laatscrg@muohio.edu), 407 Sandra Drive, Oxford, OH 45056. A Course in Mathematical Recreations.

Since 1979 Miami University has offered a topics course in Mathematical Recreations to advanced undergraduate students, most of whom have been secondary education majors. The talk will discuss the genesis, content, and requirements of the course as taught by one of its instructors, and provide samples of problems and some student contributions to the field of recreational mathematics. A printed outline of the course will be provided. (Received May 24, 2002)

5002-E1-114 Ilhan M. Izmirli* (ixi@strayer.edu), 1025 15th Street NW, Washington, D.C. 20005. Some Problems in The Theory of Equations and Number Theory. Preliminary report.

Problem 1:There are 81 trees such that each year the first tree yields 1 unit of produce, the second 2 units, and 81st 81 units. How should these be divided among 9 people so that each person gets 9 trees and an equal amount of yearly produce? The solution can be obtained by constructing a table where each column sum is 369. Assume now we have $m = n \times n$ trees, such that each year one gets 1 unit of produce from the first tree, 2 units from the second tree,and m units from the m th tree. How should these trees be divided among n people so that each person gets n trees and an equal amount of yearly produce? This leads us to an n by m system of equations a solution of which can be obtained by constructing an "almost magic" square that has some very interesting properties. Problem 2: Arrange successive numbers in a triangle so that the difference of the two adjacent numbers in a row equals the number between them in the lower row. Is there a procedure to constrcuct such triangles with n rows? Problem 3: A pair of natural numbers will be called osculatory numbers if they are perfect squares and the digits of one is a permutation of the digits of the other. For example, 169 and 196 are osculatory numbers. Can we find a rule to construct all such numbers? (Received June 04, 2002)

5002-E1-131 Homer S. White* (hwhite0@georgetowncollege.edu), Department of Mathematics, Campus Box 311, Georgetown College, Georgetown KY, 40324. Checkers, Incompleteness, and Differential Equations.

Conway, Berlekamp and Guy have a neat theorem about a checker-like gamethat received attention in a recent Mathematics Magazine article. Their proof is simple and delightful , but more importantly, it looks just like proofs in several di®erent "serious" branches of mathematics. In particular, it resembles a classical proof of Lefschetz that a certain class of second -order di®erential equations have bounded solution curves. Covering the checker game in a DE class provides a nice way to acquaint the class with the motivation for the boundedness proof. This talk will do something similar with a connection between the checker game and an incompleteness theorem in logic. (Received June 05, 2002)

5002-F1-27 Bart D. Stewart* (ab8146@usma.edu), 3078 B Webb Place, West Point, NY 10996. Motivating Math Concepts in 3, 2, 1. Preliminary report.

With the advent of technological advances, not only are the rigors of "chalk and blackboard" drills continuing to fade, but classroom learning environments are also changing. Much more than number crunching, mathematical science programs are shifting, or should be, to produce creative thinkers who can relate mathematical theory and practice to real-world applications. In the battle to educate today's student accordingly, motion pictures can serve as force multipliers!

Motion pictures tap our imagination, and our imagination helps to make abstract concepts clear. Concepts, when grasped, promote creative and critical thinkers. Hence, incorporating motion pictures in to the classroom appears to be a good idea. It is a good idea for many reasons, to include, a®ecting classroom atmosphere, sparking our imagination, and presenting math's applicability to real-world phenomena.

Our imagination, too, helps us to make sense of the ambiguous. In fact, "imagination is more important than knowledge, for knowledge is limited whereas imagination embraces the entire world...." Consequently, igniting students' imagination should come ¯rst and foremost, and then the expectation that the mathematical knowledge will follow may not be too far fetched. (Received May 21, 2002)

5002-F1-29 Tommy Ratli®* (tratliff@wheatoncollege.edu), Department of Mathematics, Wheaton College, Norton, MA 02766. Cartoon Characters and Calculus.

One of the goals in all of my classes is that the students do not view mathematics as isolated from the rest of their academic and non-academic lives. In this talk, I will discuss several writing assignments from my single variable and multivariable calculus courses that are written as letters from cartoon characters asking for the students' advice. One of the common themes is that there is almost no mathematical notation in the assignments, but they require signi¯cant mathematics to solve. (Received May 21, 2002)

5002-F1-41 Sarah J. Greenwald* (sjg@math.appstate.edu), 121 Bodenheimer, Department of Mathematics, Appalachian State University, Boone, NC 28608, and Andrew Nestler (nestler_andrew@smc.edu), Department of Mathematics, Santa Monica College, 1900 Pico Blvd, Santa Monica, CA 90405-1628. r dr r: Engaging Students with Signi¯cant Mathematical Content from \The Simpsons". Preliminary report.

Now in production of its 14th season, \The Simpsons" is an award-winning global pop culture phenomenon. But did you know that "The Simpsons" also contains over one hundred mathematical moments, with material ranging from arithmetic to calculus to Riemannian geometry? Since \The Simpsons" has been on the air for most of our college students' lives, they likely are familiar with the program and its large cast of characters, including a resident mathematician named Professor Frink. For these reasons, and because it contains so many instances of mathematics, this program is an ideal source of fun ways to introduce important concepts and motivate students towards deep understanding.

During this talk, we will discuss how use of \The Simpsons" led to signi¯cant exploration of the Pythagorean Theorem, calculus concepts, the irrationality of ¼ Fermat's Last Theorem, and the shape of space. We will discuss the bene¯ts of studying \The Simpsons" in the classroom, e®ects on the teaching and learning dynamics, di± culties encountered, and speci¯c examples of how this material can be successfully implemented. Web links to a guide to math on \The Simpsons" and numerous related classroom worksheets will be available. (Received May 24, 2002)

5002-F1-44 Brian Hopkins* (hopkins_b@spc.edu), Department of Mathematics, Saint Peter's College, 2641 Kennedy Blvd., Jersey City NJ 07306. Kevin Bacon and Graph Theory. Preliminary report.

Graph theory, the mathematics of connection, can be introduced to students at many levels of mathematical maturity. Sociologist Stanley Milgram's idea of "six degrees of separation" can be expressed in terms of graph theory, with people as vertices and edges connecting people who know each other. But the resulting graph is huge and poorly defined. There is a large collection of solid data that is readily available for study: the Internet Movie Database. The University of Virginia's Oracle of Bacon allows you to find any actor's connection to Kevin Bacon, in fact, to any other actor. Who's "far away" from Kevin Bacon? Why Kevin Bacon? Is another actor a "better" choice for the "center" of the Hollywood universe? These questions help motivate graph theory concepts, are easily addressed by the UVa site, and use student knowledge to develop mathematics beyond the familiar realm of formulas. I have used this material in junior level discrete math and freshman finite math, with very positive results ? students were highly engaged, especially some who had not distinguished themselves before. (Received May 26, 2002)

5002-F1-106 Sarah L Mabrouk* (smabrouk@frc.mass.edu), Framingham State College, Mathematics Department, 100 State Street, PO Box 9101, Framingham, MA 01701-9101. Mission Impossible, Baywatch, Perry Mason, James Bond, and Tool Time In Calculus?

Taking advantage of characters and situations from movies and television can make a project seem more enjoyable and less stressful. Use of a narrative in presenting a project provides an avenue through which to assess the student's understanding of the mathematics applied. Requiring the continuation of the narrative as the student presents the analysis of and the solution for the underlying problem provides a way in which to evaluate the student's comprehension of and ability to explain mathematics.

For this project, each narrative hides an optimization problem that the students must find, solve, and explain in a project paper that must be a written continuation of the original narrative. Students are required to explain all aspects of the underlying problem and its solution together with the mathematics that they use to solve the problem using the characters presented in the narrative.

In this paper, I will discuss my use of these narratives in Calculus I as well as present some of the web pages that students created as part of the project. I will present some of the narratives and discuss the underlying optimization problems. In addition, I will discuss student reaction to the use of these project narratives in Calculus I. (Received June 03, 2002)

5002-F1-124 William T Butterworth* (wbutterw@barat.edu), Mathematics Department, 700 E Westleigh Rd., Lake Forest, IL 60045, and Paul R Coe (CoePaul@email.dom.edu), Mathematics Department, 7900 W Division Street, River Forest, IL 60305. Come On Down* The Prize is Right in Your Classroom.

The Price is Right (TPIR) is a rich source of examples of applied probability, combinatorics, game theory and computer simulation. While some of the games played on stage by individual contestants stress a knowledge of pricing, many are also heavily based on probability. TPIR stage games are a treasury of interesting modules that can be effective learning tools in a wide range of classrooms, from Liberal Arts and Mathematics Education to Discrete Math and upper-level Probability. We'll show how students explore important mathematics and improve their problem-solving skills by analyzing some of these games; and because these examples are drawn from a familiar source, they provide special motivation for study, and often reduce math anxiety.

After a general discussion of how these games can be adapted for classroom use, we'll explore up to three different games, "Money Game," "Punch-A-Bunch," and "Spelling Bee," using short video clips. Each of these games has its own mathematical and pedagogical value. While the probability computations of "Money Game" are relatively straightforward, those of "Punch-A-Bunch" and "Spelling Bee" introduce more complex elements of strategy and decision-making. (Received June 04, 2002)

5002-G1-51 Irina A. Chernikova* (irina@akron.edu), 2068 Jennifer Street, Akron, OH 44313, Seth I. Hirshorn (shirsh@umich.edu), 108 SOE, Dearborn, MI 48128, and Deborah S. Weber (weber@uakron.edu), 426 Barrett Circle, Akron, OH 44691. Multi-Level Interactive Strategy for Teaching and Learning in Introductory College-Level Mathematics Courses.

Students in college introductory mathematics courses bring different levels of preparation to the classroom, negative attitude toward mathematics and disbelieve hey will be able to succeed. A multi-level interactive strategy to teaching and learning in such courses was developed to address these student-centered problems. Within the project students have the opportunity to build their mathematical skills individually and incrementally, without falling behind on new material, and to develop more positive attitudes toward mathematics. Elements of the new strategy include reorganization of course outline to reflect a strong logical structure of course topics; development of a four-level system of individual class and homework assignments; spiral testing with immediate test results and feedback; development of supplemental, interactive course material. Student performance levels are established using the placement tests. Students work on individual projects at home and under the structured and systematic supervision of the instructor. These projects are gradually increased in di± culty. Quizzes are used to determine if a student is ready to move to the next level. University of Akron, Summer Teaching Fellowship, funded project. (Received May 28, 2002)

5002-G1-73 Florence S. Gordon* (fgordon@nyit.edu), 61 Cedar Road, E. Northport, NY 11731. Traditional College Algebra/Trig versus a Modeling Approach: Comparing Student Performance.

NYIT conducted a comprehensive study comparing a modeling approach in college algebra/trig to the traditional course that emphasized developing algebraic skills. The modeling course features a more active learning environment, stressing the behavior of families of functions and the notion of ¯tting functions to data as two unifying themes. Students in the modeling sections were challenged with non-routine conceptual problems and realistic applications throughout. They also conducted several individual projects and wrote project reports applying the mathematical ideas and methods to sets of real-world data on topics of interest to them. They did not get an explicit emphasis on developing algebraic skills. The major issues studied in the college algebra/trig courses were how the students in both groups reacted to the two approaches and how they performed on a series of common problems on the respective ¯nal exams in terms of algebra skills. The study continued on into calculus. Based on their college algebra/trig background, the study examined how the students performed in calculus on quizzes, class tests, the ¯nal exam and their overall persistence and success rates. The students from a modeling approach outperformed in every category. (Received May 31, 2002)

5002-G1-97 Carol E. Seaman* (seaman@uwosh.edu), Mathematics Department, University of Wisconsin Oshkosh, 800 Algoma Blvd., Oshkosh, WI 54901, Jennifer Earles Szydlik (szydlik@uwosh.edu), Mathematics Department, University of Wisconsin Oshkosh, 800 Algoma Blvd., Oshkosh, WI 54901, James Marty (marty@uwosh.edu), Mathematics Department, University of Wisconsin Oshkosh, 800 Algoma Blvd., Oshkosh, WI 54901, and Stephen D. Szydlik (szydliks@uwosh.edu), Mathematics Department, University of Wisconsin Oshkosh, 800 Algoma Blvd., Oshkosh, WI 54901. Comparison of Preservice Elementary Teachers' Beliefs: 1968 and 1998. Preliminary report.

We describe the beliefs of a large sample of elementary education students as they progress through their teacher education program. The study replicates Collier's (1972) work of three decades ago. The study focuses on the beliefs of teachers about both the nature of mathematics and the teaching of mathematics using scales that measure what Collier termed an "formal-informal" dimension of belief and what today might be characterized as an instrumentalist-problem solving (Ernest, 1998) dimension of belief. We report data from both the 1968 and the 1998 replication study and draw comparisons. Data for both studies were collected from students at four stages of mathematical preparation: 1) prior to taking the ¯rst mathematics content course; 2) after completion of one content course; 3) after completion of at least two content courses; and 4) after completion of all mathematics content courses and their mathematics methods course. In our presentation we will describe di®erences in the questionnaire responses of students at each stage of their program and compare the beliefs of today's preservice teachers to those of the past. (Received June 03, 2002)

5002-G1-111 Pam Crawford* (pcrawfo@ju.edu), Department of Mathematics, Jacksonville University, 2800 University Boulevard North, Jacksonville, Florida 32211, and Nell Rayburn (rayburnn@apsu.edu), Department of Math & Computer Science, Austin Peay State University, P. O. Box 4626, Clarksville, Tennessee 37044. Pedagogical implications of college students' understandings of scale.

A complete understanding of Cartesian graphical representation is multifaceted and complex. One aspect of the interpretation and construction of meaningful graphs is the realization of the role that scale plays. Yet many college algebra, precalculus and calculus textbooks take for granted students' facility with issues of scale in that often scale is given for paper-and-pencil work, is automatically determined by graphing technology, or is the same on both axes in textbook examples. This paper presents the authors' study of the relationship between students' understanding of scale and their APOS (Action-Process-Object-Schema) function level. Fifteen college students at various mathematical levels were questioned to assess their understanding of graphical representations of functions. The authors then further explored the attitudes, understanding, and knowledge of two of the students regarding their concepts of scale as re°ected in Cartesian graphs. These students were chosen because of the richness of information in their interview responses and because the authors found various aspects of their responses surprising. The pedagogical implications of the authors' study of students' understanding of scale will be discussed. (Received June 04, 2002)

5002-G1-128 Cindy Stenger* (cstenger@mu.edu). Improving Mathematical Thinking in Undergraduates Through Involvement in a Cooperative Research Project.

This presentation highlights a research project into an applied statistics course. The NCTM Standards established thinking, reasoning, and problem solving as central goals of mathematics education and described ways to implement these goals through cooperative learning, projects, group work, and technology implementation. A central goal of mathematics education research continues to be that of understanding the nature of mathematical learning and matching instruction to this developing understanding. Mathematical thinking has been de¯ned both in terms of the views and skills which students possess. Stenger found that mathematical thinking de¯ned according to Schoenfeld was rare among university mathematics students at all levels. In order to obtain a snapshot of undergraduate mathematical thinking, Stenger identi¯ed the best and worst case students with regard to mathematical skills and views. These students were identi¯ed as mature and immature and the skills and views that provided the greatest di®erentiation between the two groups were identi¯ed. For example, it was found that immature students did not understand the importance of mathematics to them personally or the commitment, personal responsibility, and perseverance involved in doing mathematics. (Received June 05, 2002)

5002-H1-17 Catherine A. Roberts* (croberts@holycross.edu), Department of Mathematics & Computer Science, Box 100A, College of the Holy Cross, 1 College Street, Worcester, MA 01610. A course called The Science of Art.

The talk will discuss the course \The Science of Art", designed as a liberal studies course for sophomores and juniors. It was team taught by three professors AF a mathematician, a chemist and an art historian. The seminar-style course examined myriad interfaces between art and science. Sample topics included art forgery, the chemistry of stained glass, patterns in Islamic tile art and the mathematical technique of drawing in one-point perspective. This talk will present the nuts-and-bolts of designing and delivering this web-enhanced course, including a discussion of institutional support and the challenges and rewards of team teaching. (Received May 15, 2002)

5002-H1-22 Holly S Zullo* (hzullo@carroll.edu), Mathematics Department, Carroll College, Helena, MT 59625. Teaching Di®erence Equations to Business Majors.

Business majors are typically taught to calculate compound interest and mortgage payments through the use of formulas that have little or no meaning to the students. With di®erence equations, students can learn to write relatively simple models that perfectly describe the changing balances of a bank account or a loan. The models can then be studied numerically and analytically, giving students the capability of calculating a monthly balance, total interest earned/paid, and time until a loan is paid o®. The numerical solutions can be generated using Excel, an important tool for business majors. The mathematics and the spreadsheet perfectly complement one another, with di®erence equations being an ideal situation in which to use relative addressing for moving from one time period to the next, and absolute addressing to allow easy changes to a certain parameter such as interest rate. The graphical capabilities of Excel are used to generate graphs of account balances over time. This presentation will illustrate how these topics are taught in a 100-level course that has only high school algebra as a prerequisite. (Received May 19, 2002)

5002-H1-24 Michael A. Jones* (jonesma@pegasus.montclair.edu), Department of Mathematical Sciences, Montclair State University, Upper Montclair, NJ 070431. Optimization of Knaster's Inheritance Procedure and How to Use It as a Transition to Game Theory in a Math for Liberal Arts Course.

Knaster's Inheritance Procedure was proposed by Bronislaw Knaster in 1945 to divide any number of discrete goods between any number of players; it requires the players to place monetary values or bids on all of the goods. This procedure is often discussed in Math for Liberal Arts courses that concentrate on contemporary applications of mathematics for non-major students. This fair division procedure provides an opportunity to introduce optimization to students who will never learn the calculus. A simple analysis of the procedure can lead students to determine the optimal monetary values to place on the items, given the bids of the other players. The optimization problem naturally leads to pure strategy Nash equilibria of the Knaster's Inheritance Procedure when viewed as a game, thereby providing a transition between fair division procedures and game theory in Math for Liberal Arts courses. (Received May 20, 2002)

5002-H1-37 Rachel W. Hall* (rhall@sju.edu), Department of Math and C.S., Saint Joseph's University, 5600 City Ave., Philadelphia, PA 19031. Multicultural Mathematics. Preliminary report.

The study of multicultural mathematics aims to strengthen and expand students' understanding of fundamental mathematics, including arithmetic, algebra, and geometry, through comparative study of the mathematics of world cultures; to encourage students to appreciate the contributions of all cultures to the development of mathematics; to explore the connections between mathematics, art, and music; and to increase diversity in mathematics enrollment and course o®erings. This talk details a course taught in multicultural mathematics for liberal arts majors at Saint Joseph's University. I will present a sample syllabus, reading list, and ideas for student projects, and discuss student response to the course. (Received May 23, 2002)

5002-H1-54 Agnes M. Rash* (arash@mailhost.sju.edu), Dept. of Mathematics and Computer Science, Saint Joseph's University, 5600 City Avenue, Philadelphia, PA 19131. Mathematics Models in Chemistry { An Innovation for Nonmathematics and Nonscience Majors. Preliminary report.

At many colleges and universities, students in the humanities, social sciences and business majors are not required to take a laboratory science course nor a calculus course. However, there are many bright students in these programs who are capable of understanding the interconnection between mathematics and science and bene¯ting from an interdisciplinary course with depth as well of breadth of topics. This presentation discusses a course designed to ful¯ll the core requirements in mathematics and science for non-mathematics and non-science majors. One course option for these bright students is a two-semester course, with a lab component, in mathematics and chemistry taught in the Honors Program. The course, Mathematical Models in Chemistry, involves selected topics in mathematics from discrete mathematics and calculus that have applications in chemistry. The list of topics will be given with a detailed explanation of three of the units and the associated laboratory experiments. Examples of the mathematics component include matrix operations, multivariate functions, level curves, derivatives and their applications in chemistry. (Received May 28, 2002)

5002-H1-76 Ralph A Czerwinski* (rczerwinski@mail.millikin.edu), Math and Computer Science Dept, Millikin University, 1184 W Main St, Decatur, Illinois 62522. A Honors Course: Mathematics and the Visual Arts.

The students taking this course were sophomore honors students satisfying a requirement in mathematics and the natural sciences. Presenters of these courses were encouraged to be innovative and interdisciplinary while maintaining a high level of expectation. The students in my course were majors in theatre arts, music, biology, political science, and physics. In my course description I indicated that we would explore several of the many bridges between the visual arts and mathematics. Topics that I planned for us to study included mathematics as a subject matter for art, the importance of pattern and symmetry in both mathematics and art, the role of aesthetics in the development of mathematics, and the mathematical approach in contemporary art. I proposed to ¯nd interplay and commonality between the visual arts and mathematics. The students wrote short papers, solved a wide variety of mathematics exercises, lead discussions on the readings, wrote one long paper, created a math/art object, and took exams. I will discuss the organization of the course; the challenges, successes, and failures of the initial o®ering of the course; and planned revisions for next year. (Received May 31, 2002)

5002-H1-109 Evelyn C Bailey* (ebailey@emory.edu), Mathematics Department, Oxford College of Emory University, 100 Hamill Street, Oxford, GA 30054, and Fang Chen (fchen2@emory.edu), Mathematics Department, Oxford College of Emory University, 100 Hamill Street, Oxford, GA 30054. Statistics Experiments That Work, That Elicit Discussion, and That Require Problem-Solving Skills. Preliminary report.

Experimentation should be an integral part of introductory statistics courses. These experiments are either open-ended for students to design or algorithmic where a procedure is provided. This session will explore the use of both formats of experiments using the Chi-Square goodness-of-¯t model. Experiments using this model can lead to class discussions about random sampling, about appropriate procedures, and about possible extensions of experiments. A second set of experiments provides opportunities for students to use the linear regression model which can lead to class discussions of misconceptions related to linear regression. Students become excited and active learners through the use of open-ended experimentation. Three speci¯c, ¯eld-tested student experiments will be discussed in the presentation. (Received June 03, 2002)

5002-H1-123 Janet L Andersen* (jandersen@hope.edu), Dept of Mathematics, Hope College, Holland, MI 49422-9000. Connecting Science and Mathematics General Education Courses: One Approach to Quantitative Literacy.

Students often see general education requirements as disconnected courses to be checked o®. This perception is reinforced when general education science courses are primarily qualitative and mathematics courses ignore applications (scienti¯c or otherwise). At Hope College, with the partial support of NSF, we have developed 3 general education courses. The mathematics course (Mathematics in Public Discourse) is a co- or pre-requisite for the science courses (The Atmosphere and Environmental Change and Populations in a Changing Environment). The courses are connected by content themes (use of functions, graphs, and statistical analysis of data); pedagogy (exploratory labs, investigative worksheets, cooperative learning); and technology (TI-83 and CBL). In the mathematics course, students complete reading assignments prior to class. About 75% of class time is spent doing group activities using materials developed from newspaper articles, magazines, and other materials (such as advertisements and web pages). The TI-83 and CBL allow us to bring scienti¯c experimentation and data analysis into the math classroom. The mathematics course was ¯rst taught in spring 1998 and is currently taken by about 35% of the student body. (Received June 04, 2002)

5002-H1-126 Mary E. Searcy* (searcyme@appstate.edu), Department of Mathematical Sciences, Appalachian State University, Walker Hall, Boone, NC 28608. Helping Non-Majors View Mathematics as an Ill-Structured Discipline.

A powerful tool of mathematicians is being able to view mathematics as an "ill-structured discipline", where interpretation is integral to the process of doing and understanding mathematics and debates about interpretation and implications occur naturally. However, students in undergraduate mathematics courses, particularly non-majors, do not often share this view. In these cases, it may be helpful to provide students with an introductory project that allows them to broaden their perspectives of mathematics. One such project involves having students answer the question, "How many barrels of water did Columbus take with him on his voyage to the New World?" There is no "answer" for students to ¯nd because the voyage manifests have been lost. The mathematics involved is simple arithmetic, which allows accessibility and helps keep the focus on the process. Through this project students experience the need for researching a given situation, stating assumptions, translating knowledge and assumptions into mathematical structures, encountering several "possible" solutions, and evaluating and re¯ning their solution process. The experience provides a foundation in the cognitive sca®olding for a given course and challenges students' notions regarding the nature of mathematics. (Received June 04, 2002)

5002-I1-57 Je®rey A Graham* (graham@susqu.edu), Department of Mathematical Sciences, Susquehanna University, 514 University Avenue, Selinsgrove PA 17870. The Mystery of $f_{xx}f_{yy}$ ¡ $(f_{xy})^2$ Solved.

Most calculus books give the formula in the title and some conditions for determining whether a critical point of a real-valued function of two variables is a maxima, minima, saddle, or unknown. There is usually no explanation of why the formula works nor is there given any method for determining maxima or minima for real-valued functions of more than two variables. In this talk, we will show how a little bit of linear algebra and our experience from one dimensional calculus can ¯ll both of these holes. (Received May 29, 2002)

5002-I1-85 James R. Bozeman* (james.bozeman@lsc.vsc.edu), Department of Mathematics, Lyndon State College, Lyndonville, VT 05851. Polar Mysteries and Eccentricities.

In this talk I will present examples of projects assigned each time I teach multivariable calculus. These projects are designed to encourage students to further explore topics which have been covered in the class. I especially try to give projects in which technology, in particular graphing calculators and computers, can be used. The projects that the audience will work on in this presentation are: Polar Mysteries In this project students are asked to graph two polar curves and visually check for points of intersection. They are then asked to solve the two equations simultaneously. The answers to these two questions are di®erent and the students are asked to completely explain why. This project helps students to see some of the subtleties of polar coordinates as compared to rectangular coordinates. Polar Eccentricities In this project students continue their exploration into polar graphs, this time polar equations of conics that represent orbital motion. Using Kepler's laws, the role of the eccentricity, e, is investigated both analytically and graphically. For example, what must be true of orbital speeds for di®erent values of e? In particular, what happens in the case of a circular orbit vis-à-vis Kepler's Laws. (Received June 03, 2002)

5002-I1-86 **James R. Bozeman*** (james.bozeman@sc.vsc.edu), Department of Mathematics, Lyndon State College, Lyndonville, VT 05851. *Triple Integrals and the Fourth Dimension.*

In this talk I will present an example of a project assigned each time I teach multivariable calculus. This project is designed to encourage students to further explore topics which have been covered in the class. The problem also helps students to better understand these ideas, and can lead to lively discussions. The project that the audience will work on in this presentation is: The Hypervolume of the 4-dimensional Ball In this project students are asked to use triple integrals to find the hypervolume of the 4-dimensional ball. This problem requires extending the ideas used in finding the volume of the 3-dimensional ball with double integrals. It is necessary to use integral tables to solve the triple integrals in both spherical and cylindrical coordinates, and the students are also required to write the formula in rectangular coordinates. This project helps the class to better understand these coordinate systems and their uses in evaluating integrals. The fact that we are finding a result about 4-dimensions leads to many interesting discussions. The book Flatland is used as a resource for this investigation and other examples of hypervolumes over 3-spheres are exhibited. (Received June 03, 2002)

5002-I1-107 **Sarah L Mabrouk*** (smabrouk@frc.mass.edu), Framingham State College, Mathematics Department, 100 State Street, PO Box 9101, Framingham, MA 01701-9101. *Welcome To 3-Space.*

For most students, other than considering the solids of revolution examined during Calculus I, working in and visualizing mathematics in 3-space is foreign to them. While previously they considered only the x-y plane and lines and curves that they could draw in this plane, in Multivariate Calculus, students are asked to examine and to graph lines and planes that no longer must lie flat on their desktop and to analyze equations that generate surfaces that could correspond to shapes that they created using Play-Doh when they were children.

In an effort to help students to become comfortable with their study of mathematics in 3-space, I created an ongoing assignment that provides students with opportunities to explore mathematics in 3-space as they learn Maple and explore some physical situations. Part of the assignment requires students to recognize and to model the mathematics that they are studying in the world around them. In this paper, I will discuss some of the aspects of this assignment, present some of the Maple Worksheets that the students will use, and discuss some simple tools that can be used to help students to visualize mathematics in 3-space. (Received June 03, 2002)

5002-I1-122 **John B. Geddes*** (jbgeddes@cisunix.unh.edu), Department of Mathematics and Statistics, 33 College Road, University of New Hampshire, Durham NH 03824, and **Kelly Black** (kelly.black@unh.edu), Department of Mathematics and Statistics, 33 College Road, University of New Hampshire, Durham NH 03824. *Using a Force Table to Motivate Systems.*

We have adapted a standard force table used in the introductory physics courses into a dynamic experiment which allows students to explore some key concepts in multivariate calculus. We use the apparatus throughout the course to: construct systems of equations for both the static and dynamic problem; find roots for the static problem when the balance point is unknown; develop systems of differential equations and corresponding solution curves to describe the dynamic problem; motivate the notion of potential function. We revisit this experiment throughout the course, and students are required to write a report and make explicit connections between many of the central ideas examined. During the presentation we will provide an overview of the different activities for which we have used the apparatus, as well as a discussion on how it is used to tie together a variety of topics in multivariate calculus. (Received June 04, 2002)

5002-I1-127 **Robert J Hesse*** (rhesse@csbsju.edu), Saint John's University, Collegeville MN, 56321-3000. *Arch Mathematics.*

In the spring of 1999 and 2001 I incorporated a series of Mathematica projects or "labs" into a vector analysis course. These labs used the technology of a Computer Algebra System (CAS) to further develop a particular concept, solve an application, or bring together several disjoint ideas. By far the most popular lab explored the mathematics behind the Jefferson National Expansion Memorial, commonly called the Arch. Besides being a must-see for any tourist visiting Saint Louis, the Arch has some nice mathematical properties. The center of the Arch follows the path of an upside-down catenary curve: $A\cosh(t/A)$ and cross-sections of the Arch are equilateral triangles. In the lab, students found a parameterization of the Arch and used this parameterization to compute its surface area. In this talk I will go over a little of the mathematics involved to solve the problem as well as the impact the project had with the students. (Received June 04, 2002)

5002-J1-32 Ted Sundstrom* (sundstrt@gvsu.edu), Department of Mathematics, Grand Valley State University, Allendale, MI 49401. Exploration, Writing, and Proof in Mathematics.

A transition course from the problem solving orientation of calculus courses more abstract upper level courses is an important course in the mathematics major at many universities. At Grand Valley State University, a distinguishing characteristic of this course is that it is a part of the University's Supplemental Writing Skills Program. As such, the instructor is required to work with the students on revising drafts of papers before ¯nal submission. This requirement is satis¯ed with the Portfolio of Proofs, which consists of ten propositions to be proven or disproven. Students may hand in each proof to the professor two times to be critiqued. The goal is that each student will have a completed Portfolio of Proofs that will illustrate the various proof techniques that students may encounter in later courses. We attempt to achieve this and other course objectives with an active learning environment by incorporating two or three preview activities that must be completed before each class. We also use classroom activities that can be done individually or in a collaborative learning setting where students work in groups to brainstorm, make conjectures, test each others' ideas, reach consensus, and hopefully, develop sound mathematical arguments to support their work. (Received May 21, 2002)

5002-J1-34 Dora Cardenas Ahmadi* (d.ahmadi@moreheadstate.edu), Department of Mathematical Sciences, Lappin Hall, Morehead State University, Morehead, KY 40351, and Kathryn M. Lewis* (k.lewis@moreheadstate.edu), Department of Mathematical Sciences, Lappin Hall, Morehead State University, Morehead, KY 40351. Cooperative Learning and Explorations to Engage Students in Learning Proof. Preliminary report.

Morehead State University o®ers a course titled \Introduction to Mathematical Proof", which is required for mathematics majors and for students majoring in middle grades education with a math component. This course is a prerequisite for some of the upper level mathematics courses. It is important because it provides a bridge between courses with mostly computational problems (such as calculus) and courses with mostly theoretical proofs (such as abstract algebra). The presenters will talk about the use of cooperative learning and explorations in helping students learn to write and read proofs and to get them involved during class. (Received May 22, 2002)

5002-J1-43 Susanna S. Epp* (sepp@condor.depaul.edu), Department of Mathematical Sciences, DePaul University, 2320 N. Kenmore, Chicago, IL 60614. Issues in teaching the principles of logic.

Proof is sometimes regarded as a somewhat pedantic ¯nal check of statements already known to be true. This view is a reason given for presenting mathematics informally in the ¯rst two college years. However the thought processes needed for polished proofs are also needed for their discovery. In a formal proof, logical principles are used systematically to develop a coherent, complete line of reasoning from hypothesis to conclusion. In discovery, one allows oneself to make assumptions, leave gaps, jump between points, reason backward from a conclusion to what would make it true, etc. But throughout the discovery process, one needs an instinct for logical reasoning. Unfortunately students do not typically enter college with this instinct. Through close work with students in transition-to-higher-math and discrete math courses, I have come to believe that an e®ective way to improve most students' logical reasoning skills is to spend some time teaching logical principles explicitly. However, when the focus is on teaching logic as a subject, students may learn to obtain correct answers without developing the instinct for thinking logically. I will discuss methods to address this problem and help students deepen their understanding of mathematical reasoning. (Received May 24, 2002)

5002-J1-47 Je® Johannes* (johannes@member.ams.org), Mathematics Department, 1 College Circle, Geneseo, NY 14454-1401. Welcome to mathematics: a cornerstone experience. Preliminary report.

An introduction to proofs course is the cornerstone of the undergraduate mathematics major. In this course, we have the opportunity to introduce our students to the language of mathematics, to preview upper division mathematics courses and to prepare students for studying more advanced mathematics. This talk will view the course from the perspectives of the student, of the instructor, and of subsequent instructors. (Received May 28, 2002)

5002-J1-66 **Nancy Lineken Hagelgans*** (NHagelgans@Ursinus.edu), Mathematics and Computer Science Department, Ursinus College, Collegville, PA 19426. *Proof in Abstract Algebra.*

This talk addresses an Abstract Algebra course that follows, and builds on, a Discrete Mathematics course that serves as the transition to upper level mathematics courses at Ursinus College. The main topics in the transition course are logic and methods of proof, but most proofs involve uncomplicated assertions, and these proofs have a simple structure employing just one proof method. Despite these limitations, the course helps students acquire the vocabulary to discuss proofs as well as a sense of when to apply various methods of proof. In the Abstract Algebra course I use activities that take advantage of this knowledge to extend students' ability to analyze more complicated assertions and proofs. Students read a few pages of new material before class, and after a brief class lecture, they work in teams on proving related statements. We frequently ¯rst discuss a strategy for proving a complicated assertion and develop an outline for a proof with ellipsis to indicate where details are needed for completion. Students can then concentrate on the new algebraic ideas as they complete the proof. (Received May 29, 2002)

5002-J1-74 **Olympia Nicodemi*** (nicodemi@geneseo.edu), Department of Mathematics, 325B South Hall, SUNY Geneseo, Geneseo, NY 14454, and **Morris Orzech** (orzechm@mast.queensu.ca), Department of Mathematics and Statistics, Queen's University, Kingston, Ontario K7L 3N6, Canada. *Teaching Proof { Some Nagging Questions.* Preliminary report.

The last hour of our session will be devoted to an audience-based discussion of issues raised or suggested by the talks. The presentations will have dealt with the rationale, content, pedagogy and success of a "proofs" course. Still, important questions remain. What are the barriers to students accepting proof as necessary for mathematical understanding? Does our professional practice as mathematicians sometimes lead us as teachers to set too high a standard for explanations that would make us say, "you understand" to the student? Do we sometimes persist too early, or beyond a point of diminishing returns, in trying to convince students that proof, in the argot of the discipline, should be their standard for mathematical truth? Might we thus neglect or even block other avenues of discovery and investigation, such as visualization, or qualitative description, or computer-based exploration that would lead to a more student-generated and student-perceived need for proof? We hope that these questions, and those of audience members, will lead to a lively exchange of views. (Received May 31, 2002)

5002-J1-77 **Connie M. Campbell*** (campbcm@millsaps.edu), Department of Mathematics, Millsaps College, Jackson, MS 39210. *Is that what you really meant? Helping students develop precise mathematical language.* Preliminary report.

I have participated in a three-year study which was designed to clarify how students learn to understand and construct mathematical proofs. As part of this study, groups of students in a transition course were videotaped as they constructed several elementary mathematical proofs. Those proof sessions were analyzed to evaluate the methods utilized by the students as they developed and wrote proofs. The videos revealed several misconceptions the students held concerning the relationship between logic and proof. In addition, there were frequent inconsistencies between what the students said and what they wrote in their proofs. I will discuss some insights gained from hearing and watching students work, and will describe some classroom activities designed to help students develop their ability to construct mathematical proofs. (Received May 31, 2002)

5002-J1-94 **Margaret L Morrow*** (margaret.morrow@plattsburgh.edu), Mathematics Department, SUNY Plattsburgh, Broad St, Plattsburgh, NY 12901. *Students' conceptions of proof.*

This presentation will focus on material from the research literature on students' beliefs about proof. Findings that will be discussed include students' misconceptions about the nature and role of proof, and their perception of the formal aspects of proof. Some of the research ¯ndings raise questions about whether we should be doing more to address students' beliefs about proof as we try to assist them to make the transition to proof based courses. (Received June 03, 2002)

5002-J1-118 **James D. Tooke*** (jtooke@eou.edu), School of Education and Business, Eastern Oregon University, One University Blvd., La Grande, OR 97850. *Discussing or De¯ning { How Recognizing Another van Hiele Level Can Prepare Students for Proof.* Preliminary report.

The van Hiele levels are a theoretical foundation many high school geometry books use to analyze student readiness for proofs. This talk will report on research that supports a modi¯cation of the traditional levels. Awareness of this modi¯cation, and of the reason for it, could help overcome the identi¯cation of su±cient and necessary conditions that bedevils many students' approach to proof. An examination of the de¯nition of rectangle will make the point. A textbook might say that a rectangle is a parallelogram with four right angles. However, a parallelogram with just one right angle is a rectangle. It is a nice observation or discussion that the other three angles be right angles, but it not part of the de¯nition. The traditional van Hiele levels analysis is that at Level 3 students recognize necessary and su± cient conditions, hence are ready for proof. However, after a K-9 experience of seeing discussions that are called de¯nitions, many students can construct a statement about a concept using necessary attributes, but fail to recognize when those attributes are su± cient. If another level were established, say 3B, then teachers would teach through it as through the others. Level 3B would call for recognizing su± ciency, 3A for recognizing necessity. (Received June 04, 2002)

5002-J1-119 Padraig M.M. McLoughlin* (pmcl ough@mor ehouse. edu), Department of Mathematics, Morehouse College, Atlanta, GA 30314. Using a Fusion of Modi¯ed Moore, Traditional and Reform Methods to Teach Students to Do Proofs.

In this talk I will argue that the experience of doing a mathematical argument is as good a reason for the exercise as the ¯nished proof. I will discuss what the instructor can do to guide the student through an experience consistent with this point of view, while keeping psychological and philosophical underpinnings in mind. The aim of the instructional setting I will survey (for the teaching of proof) is to integrate experiential process and ¯nal product so as to realize John Dewey's vision of the ends and means becoming the same. (Received June 04, 2002)

5002-K1-39 Steven J Brams* (st even. br ams@nyu. edu), Dept. of Politics, New York University, 715 Broadway, 4th Fl., New York, NY 10003. Fair Division of Indivisible Goods.

Dividing up the property in an estate, assigning draft players to sports teams, allocating cabinet positions to political parties in a parliamentary government{these are all examples wherein indivisible goods (including people) must be apportioned. Problems that arise in making such a division fair, such as the envy caused when one person thinks that another person received more than he or she did, will be discussed. Procedures for ameliorating such problems will also be considered. (Received May 23, 2002)

5002-K1-48 Kenneth A. Ross* (ross@mat h. uor egon. edu), Department of Mathematics, University of Oregon, Eugene, OR 97403-1222. What are the odds?

Over decades of teaching elementary probability, I have emphasized that the notion of odds is an historical accident, because of gambling, and that the \right" way to look at things is via probability. In this context, I have stressed that the road to understanding is a one-way street from society's point of view (odds) to the point of view of mathematics (probability). However, I recently realized that there are examples in probability where the ideas become simpler, especially for gamblers and freshmen, when expressed in terms of odds. (Received May 28, 2002)

5002-K1-60 John C. Maceli* (macel i @it haca. edu), Department of Mathematics & Computer Science, Ithaca College, Ithaca, New York 14850. A Contemporary General Education Course.

We will discuss the curriculum for a general education course that has been taught for the past ten years at Ithaca College. This course is taken by students from all disciplines. The course teaches many of the ideas that people call \quantitative reasoning" in the context of problems arising in the everyday experiences of the students. Topics have included: lotteries, polling, math in the media, and elections. We will brie°y describe some of the units from the course along with some activities and projects. (Received May 29, 2002)

5002-K1-61 Stan Seltzer* (sel t zer @it haca. edu), Department of Mathematics & Computer Science, Ithaca College, Ithaca, New York 14850. A Math Honors Course for Liberal Arts Students.

How do you exemplify \the spirit of inquiry" (the motto of our Honors Program) in a mathematics course when many of the students are at the precalculus level? I will describe Math & Politics, a course that deals with apportionment and voting with a strong emphasis on both current events and original sources. (Received May 29, 2002)

5002-K1-68 Catherine A. Gorini* (cgori ni @mum. edu), Maharishi University of Management, Fair¯eld, IA 52557{1066. Numbers, Codes, and Society.

Codes and the mathematics behind them have become an integral, if invisible, part of society. This paper describes a general education course at Maharishi University of Management that introduces students to modular arithmetic, the methodology of modern mathematics, and the application of mod arithmetic to check digits, error-correcting codes, and cryptology. Students are encourage to develop and justify their opinions about the uses of these technologies in society. (Received May 29, 2002)

5002-K1-113 Daylene Zielinski* (dzielinski@bellarmine.edu), Mathematics Department, Bellarmine University, 2001 Newburg Road, Louisville, KY 40205. Designing And Using Rubrics To Assess And Improve Student Writing. Preliminary report.

While teaching a writing course at Bellarmine University, I have searched for a way to improve student write and make assessing student writing more time e± cient for me and useful for the students.

Because grading writing is essentially di®erent from grading math, I have had to develop techniques that allowed me to learn and execute this new type of grading. One of the most helpful techniques for both my students and me has been rubrics. I will present techniques for developing and using rubrics for assessing student writing which not only work, but also improve student writing and decrease grading time. (Received June 04, 2002)

5002-L1-14 David James Halitsky* (david.halitsky@st-hsv.com), 2928 Stewart Campbell Pointe, Thompsons Station, TN 37179. The Human Acquisition of Cartesian Coordinates and the Loss of In°exion Twixt Latin and French: A Case of Unconscious Peircean Abduction? Preliminary report.

The human acquisition of analytic geometry occurred while French was losing/had lost the case in°ections of its ancestor Latin. Although the loss of case (LOC) and the acquisition of analytic geometry (AAG) occurred in two di®erent cognitive domains, an important analogy between LOC and AAG can nonetheless be seen by comparing the ways in which: a) Latin and French indicated the grammatical function of nouns pre- and post-LOC; b) math- ematicians de¯ned the trignometric functions sine and cosine pre- and post-AAG.

Pre-AAG, sine and cosine could only be de¯ned by ATTACHING LABELS (O,A,H) to the sides of a right triangle. Post-AAG, sine and cosine could be de¯ned by orienting the triangle relative to the EXTRINSIC FRAMEWORK o®ered by a Cartesian coordinate system, rendering the pre-AAG labels unnecessary.

But since the post-AAG "Cartesian coordinate system" is an EXTRINSIC FRAMEWORK paralleled by the post-LOC EXTRINSIC FRAMEWORK of "¯xed word-order", and since the pre-AAG LABELS O,A,H are paralleled by the PRE-LOC case-ending LABELS su±xed to nouns to indicate grammatical functions (e.g. Nominative, Accusative, Dative), AAG and LOC would seem to be related by a simple analogy of the type which was to Peirce the wellspring of successful human abduction. (Received May 14, 2002)

5002-L1-21 George L. Ashline* (gashline@smcvt.edu), Box 187, Department of Mathematics, St. Michael's College, 1 Winooski Park, Colchester, VT 05439. Secondary Education Seminar in Mathematics: A Capstone Experience. Preliminary report.

Preparing students to teach mathematics at the secondary level is of critical importance, especially given the current national and local shortages in quali¯ed mathematics teachers. In this presentation, I will describe the seminar I created to provide a capstone experience for our students intending to teach mathematics at the secondary or middle school levels. This course o®ers students a context in which to prepare lessons and try di®erent methods of teaching mathematical concepts at various grade levels using various curricula. (Received May 17, 2002)

5002-L1-30 Alan Koch* (akoch@agnesscott.edu), Department of Mathematics, Agnes Scott College, 141 E. College Ave., Decatur, GA 30030. A Case For The Three Dollar Bill.

Why do we use 1, 5, 10, 20, 50, and 100-dollar bills? Is there a better choice for denominations? By using some elementary mathematics we will construct what we call an optimal currency. An optimal currency is a choice of denominations that minimizes, on average, the number of bills needed to purchase an item. The construction of the denominations will be subject to two axioms in an attempt to simplify the calculations for the customer. One interesting feature of this optimal currency is that it does not use the ¯ve, twenty, or ¯fty-dollar bill. (Received May 21, 2002)

5002-L1-36 **Allan Krill*** (allan.krill@geo.ntnu.no), Dept of Geology and Mineral Engineering, Nowegian University of Science and Technology, 7491 Trondheim, Norway. *Pseudonumerals and pseudonumerics: better symbols and words for numbers.*

Roman numerals are unfit for arithmetic, and Arabic numerals for memory. Our words for numbers (eg "one hundred and two" for 102) are cumbersome, and zero is missing. We use symbols when we work with numbers on paper, but we use both symbols and words when we work with them in our minds. Our words do not infix the symbols. The modern plague of unmemorable ID-numbers (telephones, PINs, etc) gives math-numbers a bad name. Meticulous students, potential mathematicians, may shun illogical numbers that cannot be remembered. In 1634, Herigone made a code for memorizing numbers as words. Today's code gives users great number-memory abilities, and ten new symbols (pseudonumerals) can universalize the code. The symbols are strike-through letters 0-S 1-T 2-N 3- M 4-R 5-L 6-J 7-K 8-F 9-P and represent the ten groups of consonant sounds. They are numbers, but their sounds can be made into words (pseudonums) by adding vowel sounds. The word "pseudonumeral" is a pseudonum for 012345 = STNMRL (pSeuToNuMeRaL). A pseudonum for MAA's phone number, 800 741 9415 = FSS KRT PRTL, is "he faces a cardboard hill" (he FaSeS a KaRTPoaRT hiL) Pseudonumerics are the simplest numbers ever invented. As a pseudonumeric, 102 is TSN (symbols) and "yiTiSiNy" (word.) See http://pseudonumerology.com (Received May 22, 2002)

5002-L1-40 **Kyle L. Riley*** (kyle.riley@sdsmt.edu), Kyle Riley, Dept. of Math and Computer Science, South Dakota School of Mines and Technology, Rapid City, SD 57701-3995. *Conducting an External Review of a Mathematics Program.*

The MAA Guidelines for Programs and Departments in Undergraduate Mathematical Sciences recommends the use of a periodic external review as a tool to assess the department and the mathematics program. The external review should also play a role in the strategic planning of the department. This talk will present some of the benefits of using an external review and provide an outline on how to conduct an external review. (Received May 24, 2002)

5002-L1-50 **James N Boyd*** (jnboyd19@2020.net), St. Christopher's School, Richmond, VA 23226. *MATHEMATICA as a Lever.*

This paper will present applications of MATHEMATICA which will enable the user to develop ideas in problem solving. Solutions as pursued which in the past would not have been followed up because of their computational difficulty. Problems in geometry, probability, algebra, and mechanics will be considered. The themes of this paper are the learning, teaching, and doing of mathematics through problem solving when ideas are not held hostage to the drudgery of computation. (Received May 28, 2002)

5002-L1-56 **Alex J. Heidenberg**, Department of Mathematical Sciences, United States Military Academy, West Point, New York 10996, **Elizabeth W. Schott**, Department of Mathematical Sciences, United States Military Academy, West Point, New York 10996, and **John A. Wasko***, Department of Mathematical Sciences, United States Military Academy, West Point, New York 10996. *Graphing Calculator; Friend or Foe? Preliminary report.*

Advances in technology, from graphing calculators to computer algebra systems and handheld devices, have significantly changed the college classroom. These advances have forced changes both in the way material is presented and in how and what students learn. For instructors, it has raised the question of how to inspire a conceptual and theoretical understanding of math concepts when these complex problems can often now be solved with a simple command. To further explore these questions, a 4-week classroom experiment was conducted in the introductory Calculus course at the United States Military Academy (USMA). In conducting this experiment, our goal was to determine if placing more emphasis on the theory and less on the importance of the correct answer would lead to long-term knowledge. We measured student performance via 5 different assessment opportunities over the course of two semesters. In the experimental group the graphing calculator was used extensively to graphically reinforce the theoretical and concepts in solving these problems. Control group cadets, by comparison, were free to utilize all aspects of the graphing calculator. This presentation will discuss the results and findings of our experiment. (Received May 29, 2002)

5002-L1-58 **Jeffrey A Graham*** (graham@susqu.edu), Department of Mathematical Sciences, Susquehanna University, 514 University Avenue, Selinsgrove PA 17870. *Integration in $L^2[0,1]$ is Almost Easy.*

In this paper, we will show that the set of polynomials such that

$$\int_0^1 p(x)dx = p(1) - p(0)$$

is dense in $L^2[0,1]$. (Received May 29, 2002)

5002-L1-63 **Ruth I Berger*** (bergerr@uther.edu), Department of Mathematics, Luther College, Decorah, IA 52101. *Hidden Group Structure.* Preliminary report.

You may have seen a problem like:"Show that 5, 15, 25, 35 is a group under multiplication modulo 40" in Gallian's Abstract Algebra book. This is quite puzzling to students since there is no obvious identity. Even after e= 25 has been identi¯ed, the question of determining inverses requires some thought. The above set is in fact 5*U(8), but that does not immediately explain its group structure. This talk will provide details on why k*U(n) is a group under multiplication modulo k*n, for certain k. This will allow you to produce many more such challenging examples for your Abstract Algebra students. (Received May 29, 2002)

5002-L1-78 **Mizan R Khan*** (khanm@EasternCT.edu), Department of Mathematics, Eastern Connecticut State University, Willimantic, CT 06226. *On the distribution of inverses modulo n.*

We use uniform distribution to clarify 2 results on the di®erence of an element and its multiplicative inverse mod n. This is joint work with J. Beck. (Received May 31, 2002)

5002-L1-81 **Shakir Manshad*** (smanshad@msu.edu), General Studies Department, Dona Ana Branch Community College, New Mexico State University, Las Cruces, NM 88003. *Geometric Correspondence between Points in the Scene and Points in the Image.* Preliminary report.

A major problem in image analysis and understanding is how to represent or model objects and images. To solve this problem, suitable data structures for representing objects and images must be selected. Graphical representation scan keep su±cient information about the image.

Computer graphics, which requires two-dimensional representations of three-dimensional scenes, has revived the interest in these subjects. The major mathematical tools necessary for creating displays that appear three-dimensional include methods for the solution of geometrical problems, positional transformations, and projections. Unfortunately, in computer graphics, one must follow some precise rule because computer programs can only implement mathematical formulas. If we are not pleased with the results of the application of the strict perspective rules, we must amend them in some mathematically explicit way [Pavlidis, 1982].

In this presentation I will discuss a method of computing the picture plane window. The image of the scene is obtained by projection onto the picture plane. The method of projection is perspective. (Received June 03, 2002)

5002-L1-83 **Margaret M. Balachowski*** (mmbalach@mtu.edu), Michigan Technological University, Department of Mathematical Sciences, 1400 Townsend Drive, Houghton, MI 49931-1295, and **Shari L. Stockero** (stockero@mtu.edu), Michigan Technological University, Department of Mathematical Sciences, 1400 Townsend Drive, Houghton, MI 49931-1295. *The Impact of First Year Teaching Assistants in a First Year Classroom.* Preliminary report.

Graduate teaching assistants have traditionally played a vital role in the ¯rst year math programs at Michigan Technological University. In the past, ¯rst year GTAs were involved in non-instructional lab and recitation activities. Second year students advanced to instructional duties in a freshman level class, with as much autonomy as part-time instructors, but supervised by a faculty member. Many GTAs ¯nd that balancing the roles of student and teacher, and performing both jobs well, is a daunting task. Additionally, many undergraduates place unrealistic demands on their teachers, seeing themselves as customers who demand the best product for their dollar. Recent research has shown that e®ective teaching is a learned skill, developed through institutional support, personal introspection, and analysis of teaching strengths and weaknesses. At MTU we have developed new GTA orientation and training programs that we believe bene¯t both the GTAs and their students. Based on informal student evaluations, a drop in the number of student complaints, and the self-evaluation of the GTAs, we believe the ¯rst year of our program has been quite successful. We will present an overview of the program and discuss changes and improvements we are programming for the future. (Received June 03, 2002)

5002-L1-98 **Anthony Y Aidoo*** (aidooa@easternct.edu), Department of Mathematics, Eastern Connecticut State University, Willimantic, CT 06226, USA. *On Mathematical Models in Biology.* Preliminary report.

The complexity of Biological phenomena demands the application of interdisciplinary methods to the solution of biological problems. As biology becomes more quantitative, there has been a signi¯cant upsurge in the reliance on mathematical models and concepts to analyze and predict biological phenomena. In this paper, we consider examples of mathematical models in biology. Our examples will be taken from population dynamics, molecular events and nerve conduction. We will also examine the mathematical tools applied in the development and analysis of such quantitative models in biology. (Received June 03, 2002)

5002-L1-104 Edward J. Griggs* (edlynn@execpc.com), 21355 Clarion Lane, Waukesha, WI 53186-5409. Simple Activities for Statistics.

Teaching elementary statistics presents a paradox: while statistics is, in practice, a "hands-on" discipline, the study of statistics is rather abstract, with most of the theory beyond the level of a typical sophomore business or engineering statistics class. Through a series of simple and inexpensive "hands-on" classroom activities, statistics students can be introduced in a concrete manner to the concepts of 1) treatment of data, 2) relative frequency interpretation of probability, 3) the Central Limit Theorem, 4) confidence interval and 5) hypothesis testing. This paper presents these activities along with some of the results of their use in a sophomore engineering statistics course. (Received June 03, 2002)

5002-L1-105 Sarah L Mabrouk* (smabrouk@frc.mass.edu), Framingham State College, Mathematics Department, 100 State Street, PO Box 9101, Framingham, MA 01701-9101. Wireless Phone Plan Analysis - An Opportunity for Application of Piecewise Functions.

Analysis of long-distance and wireless phone plans provides an opportunity for students to generate data, to create and to compare graphs, to determine the symbolic representation for a function which in many cases is a piecewise function, and to apply techniques for solving systems of linear equations as they analyze a real situation to which they can relate. Taking advantage of those regularly ringing, highly interruptive, at times irritating but commonly used "boxes" helps students to understand the usefulness of the mathematics that they are learning. For some students, this is the first time that they have modeled a situation that is meaningful to them.

In this paper, I will discuss my use of both long-distance and wireless phone plans in College Algebra. I will discuss the special considerations for modeling these functions as well as some of the difficulties that students have in interpreting wireless phone plans presented on company web sites. In addition, I will discuss the results of my wireless phone plan project, student reaction to the project, and present some of the student-created web pages. (Received June 03, 2002)

5002-L1-108 Evelyn C Bailey (ebailey@emory.edu), Mathematics Department, Oxford College of Emory University, 100 Hamill Street, Oxford, GA 30054, and Fang Chen* (fchen2@emory.edu), Mathematics Department, Oxford College of Emory University, 100 Hamill Street, Oxford, GA 30054. Graphing Portfolios in Calculus: Reinforcing Concepts and Inviting Creativity. Preliminary report.

Since the fall of 1993, students in calculus I and II have created graphing portfolios. The primary goal of this assignment is to reinforce graphing concepts creatively. Students use the software GRAPHMATICA to prepare at least 15 distinctly different pages of graphs. A minimum of three are designed by the students to demonstrate the important aspects of graphing using algebraic, trigonometric, logarithmic, exponential functions, and polar coordinates (calculus II). The remaining pages use combinations of graphs to create pictures around a theme chosen by the student. Evaluation of the portfolio is based on the selection of graphs, the documentation associated with the graphs, the completeness of graphing aspects in the technical graphs, the creativity of the thematic graphs, and the oral presentation of the thematic portion of the portfolio. Examples of student work will be shown at the presentation. (Received June 03, 2002)

5002-L1-110 Allison M. Pacelli* (pacelli@math.brown.edu), 112 Waterman St. Apt. 4, Providence, RI 02906. Class Groups of Global Function Fields.

A function field in one variable over a field F is a field K containing F and at least one element T, transcendental over F, such that K is a finite, algebraic extension of $F(T)$. If the constant field F is finite, we say K is a global function field. Global function fields are very similar in nature to the other class of global fields, namely algebraic number fields. In this talk, we will discuss the structure of the class group, and show, among other things, that every finite abelian group occurs as a subgroup of the class group of some global function field. (Received June 04, 2002)

5002-L1-117 Tony Julianelle* (tjuliane@emba.uvm.edu), Dept of Mathematics and Statistics, University of Vermont, Burlington, Vt. 05405. One Million Calculus Problems: Grading the AP Calculus Exam.

An overview of the organization and structure of the grading of the AP calculus exam. (Received June 04, 2002)

5002-L1-140 Derek O'Neal Bru®* (derek.bruff@vanderbilt.edu), Vanderbilt University, Department of Mathematics, 1326 Stevenson Center, Nashville, TN 37240. The Vanderbilt University Undergraduate Seminar in Mathematics: Experiences of a Graduate Student Organizer and Presenter.

The Vanderbilt University Undergraduate Seminar in Mathematics is designed to show the undergraduate community at Vanderbilt some fascinating and exciting sides of mathematics. During the course of a semester, the seminar features talks by graduate students on a variety of topics in mathematics, from set theory and abstract algebra to analysis and applied mathematics. Each talk is designed to be interesting and accessible to undergraduates, whether they're math majors or not.

One goal of the seminar is to show students the beauty and power of mathematical ideas they might not see in their regular coursework. The seminar organizers' hope is that those same students will develop a better idea of, and a keener interest in, what mathematics is and what mathematics can do.

In this presentation, one of the graduate student founders of the seminar will describe the impetus for the seminar, the organization and content of the seminar, feedback from student attendees, as well as future plans for the seminar. (Received June 06, 2002)

5002-M1-2 Joel S. Foisy* (foisyjs@potsdam.edu), Mathematics Department, SUNY Potsdam, Potsdam, NY 13676. A su±cient condition for a graph to be intrinsically knotted.

We call a graph G intrinsically knotted if every (tame) spatial embedding of the graph contains a knotted cycle. In the early 80's, Conway and Gordon showed that every spatial embedding of K_7, the complete graph on 7 vertices, contains a knotted Hamiltonian cycle. We have adapted the methods of Conway and Gordon to establish that if a graph satis¯es a certain linking condition for every tame spatial embedding, then the graph must be intrinsically knotted. Using this su±cient condition for intrinsic knotting, we have been able to show that $K_{3;3;1;1}$ is intrinsically knotted (Kohara and Suzuki had demonstrated that Conway and Gordon's proof cannot be applied directly to $K_{3;3;1;1}$), and that there is an intrinsically knotted graph with a vertex that can be removed, and the resulting graph is not intrinsically linked (contains a pair of non-split linked cycles in every spatial embedding). (Received April 26, 2002)

5002-M1-9 Matthias Beck* (matthias@math.binghamton.edu), Department of Mathematical Sciences, State University of New York, Binghamton, NY 13902-6000. Computing the continuous discretely: the quest for the volume of the Birkho® polytope. Preliminary report.

The n^{th} Birkho® polytope B_n is the set of all doubly stochastic $n \times n$ matrices, that is, those matrices with nonnegative real entries in which every row and column sums to one. A famous open problem concerns the volume of B_n, which is only known up to $n = 9$.

The Ehrhart polynomial of a polytope with integral vertices counts the integer points in the polytope as it gets dilated by an integer factor. One reason for being interested in this counting function is that its leading term gives the volume of the polytope. We will present a new way of computing Ehrhart polynomials for polytopes using complex-analytic methods. Their application to the Birkho® polytope provides an example showing that pure mathematics and computationally e±cient algorithms are not mutually exclusive. (Received May 08, 2002)

5002-M1-52 Michael O Albertson* (albertson@math.smith.edu), Department of Mathematics, Smith College, Northampton, MA 01063. Realizing Finite Groups as Euclidean Isometries.

A ¯nite set $W \subset R^d$ is said to realize the group G if the isometry group of W is isomorphic to G. The isometry dimension $\delta(G)$ of a group is the minimum dimension of a realization. Albertson and Boutin showed that realizations exist for all ¯nite groups and in particular $\delta(G) < |G|$. In this talk we will visit a few highlights and open questions. (Received May 28, 2002)

5002-M1-55 Brigitte Servatius*, Math. Sci., WPI, Worcester, MA 01609-2280. Dual-Eulerian graphs.

A dual-Eulerian graph is a plane graph which has an ordering de¯ned on its edge set which forms simultaneously an Euler circuit in the graph and an Euler circuit in the dual graph. Dual-Eulerian graphs were de¯ned and studied in the context of silicon optimization of cmos layouts. We examine the connections between the dual-Eulerian property, Petrie walks, and the connectivity of the graph. We will also consider the dual-Eulerian property for graphs embedding in surfaces of higher genus. Moreover, a polynomial time algorithm for determining zero Euler-Petrie genus of an Eulerian graph is provided. (Received May 28, 2002)

5002-M1-69 Heather M Johnston* (hejohnston@assar.edu), Department of Mathematics, Vassar College, Poughkeepsie, NY 12604. Polygonal knot theory and stuck unknots.

Imagine a polygon in three dimensions formed from a series of rigid sticks joined end to end by universally °exible joints. Two polygons are the same if one can be moved to the other without passing the sticks through each other and without changing the length or number of the sticks.

We study both open and closed chains of sticks. We prove that if the edge lengths of a ¯ve stick open chain satisfy an inequality then there are three kinds of polygons. Otherwise there is only one.

The main question in knot theory is whether or not a loop of string can be unknotted. We give an example of a polygon which could be unknotted if it were made of string. Our polygon is stuck in its tangled position, but only because we are forbidden to bend or break its sticks. (Received May 30, 2002)

5002-M1-75 Colin C Adams* (cadams@williams.edu), Department of Mathematics, Bronfman Science Center, Williams College, Williamstown, MA 01267. Combinatorics of Alternating Knots and their Generalizations.

A variety of powerful results are known to hold for alternating knots. We will discuss the ongoing e®orts to generalize these results to an assortment of other situations. (Received May 31, 2002)

5002-N1-7 June E Barrow-Green* (J.E.Barrow-Green@open.ac.uk), Centre for the History of Mathematics, The Open University, Walton Hall, Milton Keynes MK7 6AA, England. The Role of British Mathematicians in the First World War.

As a result of the anti-war stance adopted by Bertrand Russell, which led to his sacking from Trinity College and subsequent imprisonment, there is probably a greater familiarity with what British mathematicians did not do during the First World War rather than with what they did. However, several British mathematicians were actively involved in the war e®ort, the most coherent group being those gathered together by the physiologist AV Hill to work on the problems of anti-aircraft gunnery. Hill's group-known as 'Hill's brigands'-was predominantly made up of Cambridge men, its leading ¯gures being RH Fowler, EA Milne and HW Richmond. British mathematicians also worked on other topics relating to the con°ict such as ballistics, anti-submarine warfare and wireless telegraphy. Codebreaking provided the exception. It engaged the e®orts of several highly intelligent individuals, but-in stark contrast to the Second World War-there was hardly a mathematician amongst them. In the talk I shall describe how British mathematicians came to be employed in war work and explain some of their achievements. (Received May 01, 2002)

5002-N1-8 Craig G. Fraser* (cfraser@chass.utoronto.ca), Inst. Hist. Phil. Sci. Tech., Victoria College, University of Toronto, Toronto, Ont. M5S 1K7, Canada. The Concept of Variation in Nineteenth-Century Analysis. Preliminary report.

With the invention of the calculus in the seventeenth century, the concepts of change and variation became established in mathematics. The notion of the variation of a function or a curve was basic to the calculus of the variations, although it was often dealt with only implicitly. The paper examines how the variation was de¯ned and used during the nineteenth century in the researches of Carl Jacobi, Alfred Clebsch, Adolph Mayer and others. A comparison of their researches with subsequent twentieth-century work will help to illuminate both technical and historical facets of concepts of variation as they have been deployed in the theory of optimization. (Received May 06, 2002)

5002-N1-10 V. Frederick Rickey* (fred-rickey@usma.edu), Department of Mathematical Sciences, U. S. Military Academy, West Point, NY 10996-1786. George Baron, One of America's First Mathematicians. Preliminary report.

George Baron taught at West Point in 1801, but was ¯red before the United States Military Academy was founded on March 16, 1802. He used a Black Board in his teaching and may have been the ¯rst in the country to do so. After leaving West Point he founded the ¯rst mathematical periodical in the United States, the short lived Mathematical Correspondent. The contents of this journal and what little is known of Baron's life will be described. (Received May 13, 2002)

5002-N1-65 **Amy E Shell-Gellasch*** (aa7423@usma.edu), United States Military Academy, Department of Mathematical Sciences, West Point, NY 10996. *Old Books and Hidden Gems.* Preliminary report.

Old books, in particular student and instructor texts can give an interesting, telling, and at times amusing look into the teaching and social environment of an institution in the past. The West Pont library has an extensive collection of such texts for the 19th century. I will present a sampling of the gems found in these books as well as talk about what can be gleaned from them. (Received May 29, 2002)

5002-N1-102 **Hardy Grant*** (hardygrant@yahoo.com), 539 Highland Avenue, Ottawa, ON K2A 2J8, Canada. *Mathematics in the Thought of Nicholas of Cusa.* Preliminary report.

The famous 15th-century cardinal appears on at least one modern list of "great" mathematicians; on the other hand his contemporary Regiomontanus dismissed his e®orts in mathematics as "ridiculous". But whatever his technical competence, it is quite certain that Nicholas's perception of mathematics colored deeply his in°uential views on such issues as the limits of human knowledge and the relation of man to God. I shall try to sketch from both perspectives { the technical and the philosophical { the place of mathematics in the world-view of this fascinating ¯gure. (Received June 03, 2002)

5002-N1-130 **Kenneth I. Gross*** (gross@emba.uvm.edu), Department of Mathematics, University of Vermont, Burlington, VT 05405. *Elementary teachers as mathematicians { turning challenges into opportunities.*

In the late 1980s a revolution in K-6 mathematics instruction was quietly taking place across the United States under the heading of \standards based instruction." The curriculum was reorganized according to a new paradigm, new teaching and classroom strategies were introduced, more advanced and diverse topics were incorporated into the curriculum, and new so-called \standards-based" materials were published in support of the new philosophy { all of which placed enormous pressure on the K-6 classroom teacher. The theme of this talk is mathematics instruction at the elementary level, as seen through a mathematical lens focused on Vermont. Topics will include the standards-based revolution; mathematics content needs of elementary teachers; and the Vermont Mathematics Initiative (VMI), a heavily content intensive, masters degree granting, comprehensive statewide mathematics professional development program for elementary teachers in Vermont. (Received June 05, 2002)