

# Program

## 2009 Governor's Institute in Mathematical Sciences

June 21 - 26, 2009

Approximately 30 top Vermont mathematics students from grades 9-12 will participate in the **2009 UVM / GIV Mathematical Sciences Institute, June 21 - 26, 2009**. Participants will explore topics such as chaos, fractals, robotics, networks, mathematical games and mathematical problem solving. Students will work on a hands-on project designing and testing catapults. Students will visit Burton Snowboards to investigate production, research and development at the company.

### **Spontaneous Synchronization and other Nonlinear Crazyiness**

The word 'nonlinear' is usually used to describe phenomena which are difficult to predict using mathematical models, e.g. the price of a stock or the path of a hurricane. Yet many nonlinear systems are remarkably well behaved. This course will draw on examples from the fields of astronomy, biology, engineering, physics, and atmospheric science to demonstrate the principles behind ordered chaos. It is taught by Professor Chris Danforth of the UVM Mathematics Department.

### **Decisions, Decisions, Decisions!**

In this course we will explore how mathematics can be used to make good choices and also analyze decisions once they are made. Topics to be addressed are voting methods, power indexes, and fair division. This course is taught by Karla Karstens of the UVM Mathematics Department.

### **The Numbers in your Life**

What kind of math do people use every day? We'll explore some of the math behind statistical studies, probability, and money.... This course is taught by Sheila Weaver of the UVM Statistics Program.

### **Why people do mathematics: the case of Sonya Kovalevskaya**

What motivates people to make the abstractions that so annoy many people and so fascinate mathematicians? After an exploration of the actual words of some ancient mathematicians explaining why they were doing mathematics, we'll look at one particular mathematician---Sonya Kovalevskaya (1850--1891)---and see what her motives were for becoming the first woman professor "through (nearly) regular channels". This course is taught by Roger Cooke, Professor Emeritus of the UVM Mathematics Department.

### **Juggling Probabilities**

From the right perspective, everything is mathematical – even juggling. I'll describe how juggling relates to traditional mathematical fields such as graph theory and look at what happens when a person starts juggling randomly. In doing so, I'll illustrate how these mathematical underpinnings can be useful even to accomplished jugglers. There will be numerous live demonstrations. This course is taught by Greg Warrington of the UVM Mathematics Department.

### **The Stable Marriage Problem**

Imagine you are a matchmaker with 20 female clients and 20 male clients. Each of the women has given you a complete list of the men ordered by her preference of whom she would like to marry. Similarly, each of the men has given you a

complete list of the women ordered by his preference of whom he would like to marry. Your job is to find a "stable marriage". This would be a total of 20 marriages (between all the men and all the women) such that there is no pair of a man and a woman who both prefer each other to their partner in the marriage? Can you do it???. This course is taught by Jeff Dinitz of the UVM Department of Mathematics.

### **Problem Solving Strategies**

This session is taught by Mike Kling, sophomore at MIT, and past Vermont High School Prize in Mathematics state champion.

### **Computer Animation with *Mathematica***

In this session we will use *Mathematica*, a powerful computer algebra system, to create computer animations. We will begin with equations for familiar figures such as circles and lines, and modify the equations to produce figures that move across the screen, change size or shape, etc. This course is taught by Helen Read of the UVM Department of Mathematics.

### **Using Shadows at "High Noon" to Estimate the Circumference of the Earth**

In this activity we will recreate an experiment conducted by Eratosthenes over 2000 years ago. We will use shadows cast at high noon, some primitive measurement tools, and some mathematics to estimate the circumference of the earth. How will our estimates stack up to those done by Eratosthenes? This course is taught by Krisan Geary of the UVM Department of Mathematics.

### **Sundials**

More on using the sun, shadows and geometry to tell time and more... This course is taught by Bill Gottesman.

### **The game of hex**

Abstract: The game of hex is a 2-player connection game invented by Danish engineer Piet Hein, and later by Nobel Prize winner John Nash, in the 1940s. If your bathroom floor is covered by hexagonal tiles, then you have a playing board by taking the diamond formed by 11 hexagons in one direction and 11 in another direction. Players take turns placing their mark, as in tic-tac-toe, on a hexagon and the winner (there is guaranteed to be one) is the person who has formed a connection from one side of the board to the other with his marks. We will investigate strategies for play, interesting mathematics that connects with the game and some open questions. This course is taught by John Schmitt of the Middlebury College Department of Mathematics.

### **Ringling Mathematics**

Change Ringing is a form of ringing bells in mathematical patterns. In this session we will use modern mathematics to examine this centuries-old art. Participants will then take turns ringing handbells according to a few of the traditional methods. This course is taught by Priscilla Bremser of the Middlebury College Department of Mathematics.

### **Tour of Ben & Jerry's**

Ben and Jerry's mission is to make, distribute & sell the finest quality all natural ice cream & euphoric concoctions with a continued commitment to incorporating wholesome, natural ingredients and promoting business practices that respect the Earth and the Environment. We'll tour their factory with the engineers who make this tasty product the success it is...