# Student Schedule

**Math Day 2019**

**March 25, 2019**

## Schedule at a Glance

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 am – 8:55 am</td>
<td>Check-in: Kane Hall, 1st Floor Lobby</td>
</tr>
<tr>
<td>9:00 am – 9:10 am</td>
<td>Welcome Address: TBD</td>
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<tr>
<td>9:10 am – 9:55 am</td>
<td>Plenary Address: <strong>Adventures in Topology</strong>, Kristin DeVleeming, Assistant Professor, Mathematics, UCSD Live in Kane 130; streaming in Kane 110 and Kane 120 (Admission is limited to room capacity.)</td>
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<tr>
<td>10:15 am – 10:55 am</td>
<td>Session I: Field Trips leave from outside Kane Hall Lobby at 10:05 am</td>
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<tr>
<td>11:15 am – 11:55 am</td>
<td>Session II: Field Trips leave from outside Kane Hall Lobby at 11:05 am</td>
</tr>
<tr>
<td>Noon – 1:10 pm</td>
<td>Student Lunch: We recommend students bring lunch. The HUB on campus has a very limited number of eateries open for purchasing lunch.</td>
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<tr>
<td>Noon – 1:10 pm</td>
<td>Teachers’ Lunch and Activity: TBD</td>
</tr>
<tr>
<td>1:20 pm – 2:00 pm</td>
<td>Session III: Field Trips leave from outside Kane Hall Lobby at 1:10 pm</td>
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## Cutting Edge Topics in Mathematical Science Presented by Top Faculty and Professionals

**Students do not need a ticket to attend the lectures below. Admission is limited to room capacity.**

<table>
<thead>
<tr>
<th>Session I: 10:15 – 10:55 am</th>
<th>Session II: 11:15 – 11:55 am</th>
<th>Session III: 1:20 – 2:00 pm</th>
</tr>
</thead>
</table>
| The Computational Complexity of Polynomials  
Jarod Alper, Associate Professor, Mathematics, UW  
Location: TBD | Mathematical Skyscrapers  
Monty McGovern, Professor, Mathematics, UW  
Location: TBD | Keep it Up: How to Juggle Numbers  
Adam Kapilow, Graduate Student, Mathematics, UW  
Location: TBD |
| Art and Mathematics: Tactile Math Patterns in Clay  
Sara Billey, Professor, Mathematics, UW  
Location: TBD | How to Be Extremely Good at Dots and Boxes  
Jonah Ostroff, Lecturer, Mathematics, UW  
Location: TBD | On Playing Golf with Two Balls and Probabilistic Decision Making  
Ioana Dumitriu, Professor of Mathematics, UW  
Location: TBD |
| Random Symmetry  
Noah Forman, Assistant Professor of Mathematics, UW  
Location: TBD | From Plato to Riemann: Straight Lines on Platonic Solids  
Jayadev Athreya, Associate Professor of Mathematics, UW  
Location: TBD | Warped Spaces  
Alex Nichifor, Senior Lecturer, Mathematics, UW  
Location: TBD |
| No Numeration Without Representation  
Tom Edgar, Associate Professor of Mathematics, PLU  
Location: TBD | Symmetry, Topology and the Nobel Prize  
Jonathan Beardsley, Professor, Mathematics, UW  
Location: TBD | Finding Patterns in Differences: the Mathematics Behind the game SET  
Bianca Viray, Associate Professor, Mathematics, UW  
Location: TBD |
| Panel Discussion: Undergraduate Life  
Undergraduates will discuss courses, activities, and will answer questions.  
Location: TBD | Building Swept Solids: Math from Hoop to Knots  
Duane Storti, Professor, Mathematics, UW  
Location: TBD | Beyond Infinity  
Bryce Goodwin, Undergraduate Student, Mathematics, UW  
Location: TBD |

## Drop-in Activities – Tickets Not Required

**Students do not need a ticket to attend the activities listed below. Please go directly to the location indicated. (Capacity is unlimited and drop-ins are welcome!)**

<table>
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<th>Activity</th>
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<tr>
<td>Problem-Solving Strategies with Puzzles</td>
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not true that a line has a unique parallel through a given point? The familiar set of rules for lines and angles on a plane is just one possibility for the

No Numeration Without Representation

A complicated version of "eeny, meeny, miny, moe," some two-player token collecting games, a mystery of identifying a counterfeit coin, and the 27-card magic trick can all be explained by letting go of our usual method of representing the numbers involved. After describing each of the problems, we'll pursue a "choose-your-own-adventure" path to showing how nonstandard numerical systems give rise to interesting solutions to the problems.

Panel Discussion: Undergraduate Life – Come hear undergraduates discuss their classes, activities, interests and life at the UW.

SESSION II – 11:15 – 11:55 am

Mathematical Skyscrapers - Think mathematicians don't do engineering? Think again! Mathematicians build infinite towers called continued fractions to represent real numbers; in so doing they get insights about them that their decimal expansions don't reveal. Come to this talk and bring your hard hats!

Random Symmetry - We will experiment with random sequences in which order doesn't matter. These sequences have really surprising behavior from an "oracles-eye view," where you can see overall long run behavior but not specifics. We will discover why these sequences are a good model for learning, both in humans and in computer programs.

How to Be Extremely Good at Dots and Boxes - Dots and Boxes is a pencil-and-paper game that you may have played before: draw a square array of dots, take turns drawing lines between them, and try to complete more boxes than your opponent. The rules are quite simple, but the math is remarkably complicated! We'll learn a few layers of strategy you can use to astound and humiliate your friends, and then discuss how variations in the rules can affect this strategy.

Building Swept Solids: Math from Hoop to Knots - A whirlwind tour of math actually used by an engineer. Discussion includes algebra and geometry with a smidgen of calculus, a tangent on 3D printing, culminating with some hands-on number theory.

Symmetry, Topology and the Nobel Prize - Several physicists, including one from UW, recently won the Nobel Prize in Physics for their study of the mysteriously named "topological phases of matter." In this talk, I'll describe how the usual phases of matter we're familiar with, like gas, liquid and solid, are related to the amount of symmetry in a material. When the temperature gets low enough, many new kinds of symmetries arise that we don't see in everyday life, and these lead to so-called topological phases. I'll give a gentle introduction to the main ideas of topology and describe how a number called the "genus" of a surface (which is really just how many holes it has!) controls the possible symmetries, and so also controls all the possible topological phases!

SESSION III – 1:20 – 2:00 pm

Keep it Up: How to Juggle Numbers - Over the past few decades juggling and mathematics have had a wonderful interplay. Jugglers have used mathematics to discover and learn new patterns, and juggling has inspired new and interesting mathematics. In this talk we'll take a first look at this connection by exploring siteswap notation, a way to represent juggling patterns with numbers.

On Playing Golf with Two Balls and Probabilistic Decision Making - Often, we are faced with situations where the outcome of our next action is uncertain. It may depend on a coin flip, or whether someone answers the phone when we call them. How can we choose among the many possible paths to our goal? We will construct a mathematical metaphor for this scenario, and show how Probability, our eternal frenemy, can be used to help us identify the best one (well, at least most of the time).

Warped Spaces - What would the world look like if you lived in a strange place where the sum of the angles in a triangle is not 180 degrees, and it's not true that a line has a unique parallel through a given point? The familiar set of rules for lines and angles on a plane is just one possibility for the geometry of a space. We'll take a look at alternative, non-Euclidean geometries, and the resulting "curved" spaces. Some Escher prints show wonderful models of such worlds. In fact, modern physics suggests that our own universe is non-Euclidean, despite our intuition to the contrary.

Beyond Infinity - In this lecture we will investigate some of the ways in which mathematicians use the concept of infinity. We will consider how infinity is used in non-mathematical language and from this build a definition that is appropriate for mathematics. We will then examine how infinity can be used as a number, and how notions of size and order apply to infinite sets. If time permits we will also introduce how these ideas relate to more subtle topics in set theory, like Russel's paradox, the continuum hypothesis, and the axiom of choice.
Finding Patterns in Differences: the Mathematics Behind the Game SET - SET is a card game where the goal is to find collections of three cards where each of features (color, shape, number, and shading) are all the same or all different. This simple game surprisingly leads to lots of interesting mathematics, including a question which remains unsolved!

Information Session: UW Admissions – Hear from a UW Admissions representative about the ins and outs of the admission process.

ACTIVITIES – TICKETS NOT REQUIRED

Have some free time??? Visit the all day drop-in puzzle activity below in Kane Hall Lobby.

Problem-Solving Strategies with Puzzles (All Sessions) - Investigate some playful math challenges in tessellating, spatial reasoning, and interactive problem-solving. Puzzles are provided by Math 'n' Stuff (8926 Roosevelt Ave. NE, Seattle, 206-522-8891).

FIELD TRIP & ACTIVITIES ABSTRACTS – STUDENTS MUST HAVE A TICKET TO ATTEND

Students who do not have a ticket should proceed directly to the Activity/Field Trip standby line located Right outside Kane Lobby. If a field trip or activity still has spots for more students before they depart, they will stop at the stand by line. Students will then be added starting from the front and working to the back. 1-2 staff members (in bright yellow vests) will manage the standby line.

Students in line should be prepared to raise their hand and speak up if the activity of interest is offered.

Students waiting in the standby line are not guaranteed access to their desired field trip or activity.

Have tickets you know you will not use? Ticket swapping among students is allowed and encouraged.

Unused tickets can also be given to the registration desk at any time or to a staff member at the stand by line.

Applied Physics Lab (All Sessions) Applied Physics Laboratory Tour —The North Polar ice cap has thinned by 30% in the last 20 years. Internal bleeding can be stopped, tumors can be “cooked,” and kidney stones can be pulverized—all with ultrasound. An underwater glider literally glides untethered through the ocean without a propeller and can remain underway for up to one year collecting oceanographic data. An ocean observatory is now operational, consisting of fiber optic cables and geophysical and geophysical instruments on the small tectonic plate off the coast of Washington and Oregon called the Juan de Fuca plate. This project enables anyone to look in on the ocean and seafloor off our coast. The science, engineering, and mathematics behind these discoveries and devices will be presented and/or demonstrated. The actual topics covered will depend on the availability of personnel and equipment.

Campus Tours (All Sessions) - Tour the University of Washington campus.

Knights and Liars (Sessions II & III) - During the lecture, students will work on the collection of logical problems of increasing difficulty about liars and knights, princesses and tigers, and so on. We’ll be using these problems to explore certain aspects of mathematical logics: elements of Boolean algebra, logical operators, truth tables.

Mathematical Card Tricks (Sessions I & II) - Learn how to impress your friends and family with a deck of cards and your brain. No sleight of hand is necessary, just some clever math. The ideas involved are based on a relatively young field of mathematics called Combinatorics. Combinatorics is the study of discrete objects, counting arrangements of those objects, and optimizing their properties.

Paper Origami (All Sessions) - The class will introduce students to a process that allows us to fold spherical models from one sheet of paper. Students will fold two to three models depending on time and skills.

Planetarium (All Sessions) - Come explore astronomy at the UW planetarium! Learn about the night sky, stars, galaxies and the planets in our solar system. Get an up close look at nebulae and galaxies, or zoom out to the farthest edges of the universe, all on a 30 foot dome with an all-digital system powered by Microsoft’s Worldwide Telescope.

Plasma – The Fourth State of Matter (All Sessions) – Plasma is a super-heated gas that has unique electromagnetic and fluid properties, which make it relevant to fusion energy, and advanced space propulsion, photolithography, and astrophysical jets. The ZaP Flow Z-pinch experiment at the University of Washington explores an innovative plasma confinement concept that uses the JxB force to compress and a sheared flow to stabilize an otherwise unstable plasma. Because the plasma temperature easily exceeds 1 million degrees, highly advanced instruments must be used to make measurements without perturbing the plasma.

Problems and a Piece of Paper (Sessions II & III) - What really is mathematics? We will attempt to answer this question by exploring the history of origami, and by creating our own conjectures through a hands-on paper folding activity.

Seismology Lab (All Sessions) – Visit the home of the largest seismic network in the United States outside California. The Pacific Northwest Seismic Network (PNSN) operates a real time network of 250 seismometers in Washington and Oregon, monitoring earthquake activity and the Cascade Volcanoes as a partner agency of the Cascade Volcano Observatory.