Department of Mathematics

Newsletter

Spring 2025

Inside >>>

What We Do...

The Cal Poly Humboldt Mathematics Department strives to provide excellent instruction in mathematics, statistics, data science, and quantitative reasoning. To accomplish this, we...

Provide all students with quantitative reasoning skills and mathematical literacy for productive citizenship, recognizing that mathematical talent exists in every community and background

Equip students in client disciplines with the mathematical and data analysis concepts necessary for effective work in their fields, acknowledging that mathematics builds bridges between diverse disciplines

Prepare mathematics and data science majors and minors with strong foundations for professional careers, teaching, or graduate study, while fostering collaboration that enriches mathematical understanding

Create learning environments where curiosity drives discovery and each person's unique perspective is valued

Promote mathematics and data science as shared human endeavors that cross all boundaries and connect diverse communities

$$\begin{array}{ccc} V^* \otimes V^* \otimes V \otimes V & \xrightarrow{\mu_S \otimes \mu_A^!} & S_2 \otimes A_2^! \\ \downarrow{\scriptstyle \nu_1} & & \downarrow{\scriptstyle \nu_2} \\ \mathrm{Hom}(V^* \otimes V^*, V \otimes V) & \xrightarrow{\pi} & \mathrm{Hom}(I \oplus \mathbb{K}F, V^* \otimes V^*/I) \end{array}$$

What does this 'magic square' diagram reveal about the universe's fundamental structure? Cal Poly Humboldt mathematics professor Peter Goetz develops advanced algebraic methods that build bridges between pure mathematics and quantum physics. Discover how this diagram unlocked a mathematical breakthrough and how non-commutative algebra is a tool used by physicists to understand our reality on page 11.

Cal Poly Humboldt.

From the Department Chair

A Note From the Department Chair - Tyler Evans

After a decade focused exclusively on teaching and research, I'm excited to return to the department chair role. During my time away, our department evolved alongside the university through multiple leadership transitions and significant institutional changes. The most transformative development has been our evolution into Cal Poly Humboldt—the CSU system's third polytechnic university. This transition created exciting opportunities, including our new B.S. in Data Science program which directly responds to workforce demands and has already attracted talented faculty.

Internally, we've streamlined our mathematics major into a unified degree that balances strong theoretical foundations with practical programming and problem-solving skills. We've also adapted to system-wide changes like the elimination of developmental mathematics classes and refocused our department exclusively on undergraduate education. Throughout these transitions, our core commitments remain unchanged: supporting student scholarships, promoting faculty excellence in teaching and research, and maintaining our weekly mathematics colloquium—now the longest uninterrupted seminar series on campus.

The pandemic presented unique challenges, but we've rebounded successfully. Our mathematics study space now bustles with student activity, our Math Club has reactivated, and we've launched a new Data Science Club to support students in this growing field.

Personally, my decade in the classroom teaching courses from college algebra to advanced theoretical subjects has been immensely rewarding. The direct connection with students at all levels continually renews my appreciation for our educational mission.

Looking ahead, I'm energized about our future as we chart a course for mathematics and data science education at Cal Poly Humboldt. I hope you enjoy catching up with our department's activities, our alumni accomplishments, and the pursuits of your favorite professors in retirement!

Student Clubs

Math Club - Aaron Ramirez

The Math Club at Cal Poly Humboldt is a welcoming community for students who share a passion for mathematics. Math Club meetings are a place for members to talk about interesting problems, participate in engaging activities, seek out advice, and connect with others who appreciate math.

Throughout the year, we host study sessions, math-related game nights, guest lectures, and problem-solving challenges. We also provide avenues for students to further their education by providing links and contact information on REUs, Cal-Bridge programs, and other resources.

Advised by Professor Walden Freedman, the club officers are **Aaron Ramirez** (President) and **Sela Raisl** (Treasurer).

Whether you're a math major or simply enjoy puzzles and logical challenges, everyone is encouraged to join!

Data Science Club - Martin Mendoza-Ceja

The Data Science Club is a community of students passionate about exploring the world of data and machine learning. Whether you're a beginner or have experience in the field, our club provides opportunities to learn, collaborate, and apply data science skills to real-world data. This year, we attended DataFest 2025, explored the GeoPandas module, and held discussions on emerging topics like machine learning and data visualization.

Our current officers are **Martín Mendoza-Ceja** (President), **Zachary Griffith** (Vice-president), **Aiden Thakur** (Treasurer), and **Jaiden Roe** (Secretary). The club advisor is Professor Bethany Johnson.

We welcome students from all backgrounds with no prior experience required! If you're interested in learning more, feel free to stop by our meetings (Wed 5-7pm @ BSS313) or reach out for more details.

Student Outreach

Call Night - Tyler Evans

On March 13, the Mathematics Department held its annual "Call Night" as part of the university's recruitment efforts for new students. Mathematics and Data Science majors **Jonathan Juarez**, **Mack Kona**, **Megan Pratt**, **Aaron Ramirez**, and **Anthony Wolfe** worked the phones from 5 to 8pm to contact recently admitted students.

The student callers congratulated prospective students on their admission to Cal Poly Humboldt and offered to answer questions about the Mathematics and Data Science programs. For some admitted students, this call was their first notification of acceptance, leading to excited conversations and congratulations from our student volunteers!

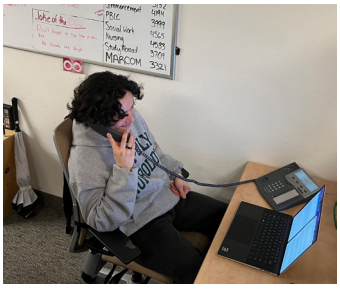
Admitted students asked about various aspects of campus life, including what classes are like, whether faculty are approachable, recreational activities in the area, and campus parking. Our student volunteers drew from their own experiences to provide honest and helpful responses.

This personal outreach helps make the transition to college less intimidating for new students by connecting them with current majors who can share authentic perspectives on the Cal Poly Humboldt experience.

Math and Data Science students on the phones during call night.

Clockwise from the top-left: Megan Pratt, Mack Kona, Jonathan Juarez, Anthony Wolfe and Aaron Ramirez.

Photos: Tyler Evans



REUs

Math Meets Marine Biology - Sela Raisl

Last summer, I was accepted into an NSF-funded research program called the Coastal Heartland Marine Biology Exchange Research Experience for Undergraduates (REU). This program focused on building research and analytical skills through long-term ecological research (LTER) projects. It was established by collaborating with three universities: the University of Kansas, the University of Virginia, and the University of California Santa Barbara.

I spent my first five weeks of this program working in the lab at the University of Virginia and collecting data along the coast. This experience was amazing, and I got to meet many talented people and experience multiple approaches to data collection. We sampled fish, invertebrate, and seagrass populations to add to a long-term database.

Following the data collection, I spent four weeks in Kansas with a quantitative ecologist named Dan Reuman. That portion of my research was interesting because I had to utilize the program R to clean and analyze the data I collected and interpret the results. It was challenging at first to modify the datasets into a workable format with the information I wanted, but eventually, I was able to run matrix models and linear models on the data. My work showed that seagrass density and water depth impacted fish and invertebrate populations, and I found a potential relationship between fish consumption and invertebrate populations.

For the last week of my experience, I attended the ESA conference in Long Beach, met many talented ecologists, and learned about other current research projects. Overall, this was a super fun project to be a part of and I highly recommend participating in an REU if you ever get the chance!

Mathematics and Marine Biology double-major Sela Raisl gathers fish, invertebrate, and seagrass population data off the Virginia coast during her summer 2024 REU program.

RESEARCH EXPERIENCE FOR UNDERGRADUATES
National Science Foundation

Mathematical Contests

Fall 2024 Integration Bee - Tyler Evans

The Integration Bee continued this November, marking a particularly special occasion as Professor Jeff Haag presided over the competition for his final year as director.

In the contest, participants tested their mettle against challenging integration problems, racing both against each other and the clock to solve definite and indefinite integrals.

Under the watchful eyes of judges Professor Ken Owens and Tim Lauck, with Professor Yoon Kim serving as official timer and photographer, four students competed in this year's contest. **AJ Fick** claimed first place, followed by **Spencer Hoyt** in second. **Austin McAskill** and **Anthony Wolfe** rounded out this year's field of competitors, with all participants demonstrating impressive integration abilities.

Professor Haag founded the Integration Bee 19 years ago and has guided it ever since. His creation has challenged and inspired countless students, and his commitment to friendly competition and mathematical education has shaped our department. As he passes the torch of directorship, we extend our gratitude for his vision and dedication. And of course, we'll +C you next year, under new direction but with the same spirit of mathematical adventure!

Above: 2024 Bee contestants (left to right) AJ Fick, Anthony Wolfe, Spencer Hoyt and Austin McAskill.

Right: Bee director and founder Professor Jeff Haag.

H.

$\mu\alpha\theta$ The spring 2025 Mu Alpha Theta contest took place on April 19. Written and directed by Professors Walden Freedman and Peter Goetz, students once again sat down to solve a variety of problems at different levels of mathematical background with possible prizes ranging from $50 to $200. This year, twelve contestants gathered in the BSS building on a Saturday morning to compete.

The contestants were (in alphabetical order): **Jacob Barth**, **Rodney Eckler**, **Kole Fisher**, **Iain Fox**, **Ailor Gray**, **Chloe Hammond**, **Kenji Hatchimonji**, **Saul Jimenez**, **Jaimie Lerma**, **Jacob Lewis**, **Chase Loughmiller**, and **Peter McGinnis**.

Results were not yet available at the time this newsletter went to press. Congratulations to all participants!

The Putnam Exam - Walden Freedman

The prestigious and challenging William Lowell Putnam Mathematical Competition takes place across North America each year on the first Saturday in December. The exam consists of twelve problems, six in the morning and six in the afternoon. Each problem is worth ten points, allowing for a possible total score of 120. Students work on the problems individually.

The most recent competition took place on Saturday, December 7, 2024. A total of 3,988 students from 477 institutions participated. Out of 120 points possible, the top score was 90, with the average score approximately 8 and a median score of 2, which is somewhat typical and reflects the level of rigor and difficulty of the questions.

Five students from Cal Poly Humboldt participated: **Kenji Hatchimonji**, **Jacob Lewis**, **Chase Loughmiller**, **Sander Swenson**, and **Desmond West-Hedlund**, with one student getting a positive score. The competition was proctored by Professor Walden Freedman. Participants were recognized at the annual student awards ceremony at the end of the spring semester.

Below is the first problem (A1) from the competition (usually the most accessible):

Determine all positive integers n for which there exist positive integers a, b and c satisfying

$$2a^n + 3b^n = 4c^n.$$

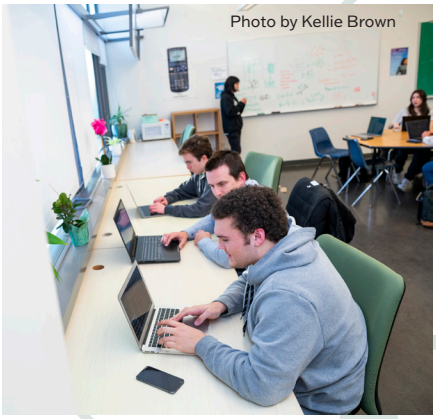
The 86th Putnam Competition will take place on Saturday, December 6, 2025, with registration opening on Tuesday, September 2, 2025. Please see Professor Freedman if you have questions about participating or for help preparing for the competition.

Mathematical Contests

Mathematical Contest in Modeling - Kamila Larripa

Our department had two teams compete in the 2025 Mathematical Contest in Modeling from January 23-27. In this international contest, teams of three competitors are challenged to propose a mathematical model to a problem and use it to gain insights and then summarize their work in a solution paper for judging.

John Gerving, **Sander Swenson** and **Desmond West-Hedlund** formed a team and selected a data-driven problem related to Olympic medals. They were asked to develop a model for medal counts for each country and then make projections for the 2028 Olympics to be held in Los Angeles. Projections needed to include those for countries which have not yet won medals. They were also asked to examine the impact of the "great coach" effect. For example, Lang Ping coached both the United States and China to great success in volleyball.



Students (top to bottom) John Gerving, Sander Swenson and Desmond West-Hedlund work on their Olympic medal count model.

The students approached this challenge with a linear regression model and generalized time series forecasting, as well as a logistic regression model. They also developed a mechanism for detecting a "great coach effect" and made recommendations for specific countries to consider recruiting such a coach to increase their medal count at the Los Angeles Games. Suggestions included Sweden, Germany and France hiring a "great coach" for cricket, baseball, softball and surfing. It will be exciting to watch the 2028 games and see if these countries have done so!

Mack Kona, **Megan Pratt**, and **Aaron Ramirez** formed a team and selected a problem related to maintaining sustainable tourism in Juneau, Alaska. Juneau hosted over 1.6 million cruise ship passengers in 2023, which bring important revenue into the small town, but also impact Medenhall Glacier, one of the premier attractions. The glacier has been receding due to warming temperatures. Tourism has hidden costs, such as pressure on local infrastructure and an increased carbon footprint. This team was asked to build a model for sustainable tourism in Juneau, and then generalize the model so it could be adapted to other ecologically sensitive regions.

This team's work included an analysis of the most detrimental activities to the glacier, and also acknowledged the dependency of the town's economic livelihood on tourism. They worked to quantify the environmental cost and revenue from various activities, and propose a glacier quarantine and the relocation of excursions (such as dog sledding) to less sensitive areas.

Our students worked extremely hard over these four days, and demonstrated not just mathematical skills, but teamwork, time management, and excellent scientific writing and visualization skills. We are extremely proud of our students and view this as an experience that integrates their coursework and education at Cal Poly Humboldt Math! Contest results will be posted here in the late spring: https://www.contest.comap.com/undergraduate/contests/mcm/previous-contests.php.

DataFest 2025 - Bethany Johnson

Cal Poly Humboldt is sending three student teams to the American Statistical Association's annual DataFest competition. This year the Northern California section of the competition was held at Sacramento State April 11 - 13. In this intense 48-hour event, teams work with a large, complex dataset, uncover key insights, and present their findings to a panel of judges and a live audience. This year's participants include **Evan Blem**, **Martín Mendoza-Ceja**, **Lu Cronin**, **Zachary Griffiths**, **Sam Orr**, **Elio Piccagli**, **Jaiden Roe**, **Aiden Thakur**, **Orlando Trujillo-Ortiz**, **Dylan Westigard**, and **Anthony Wolfe**.

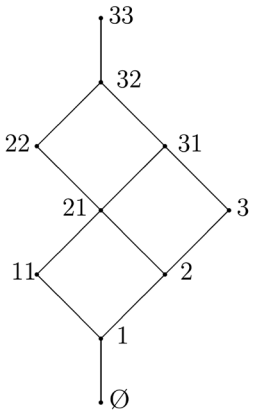

Cal Poly Humboldt 2025 DataFest Teams at Sacramento State

ASA DataFest

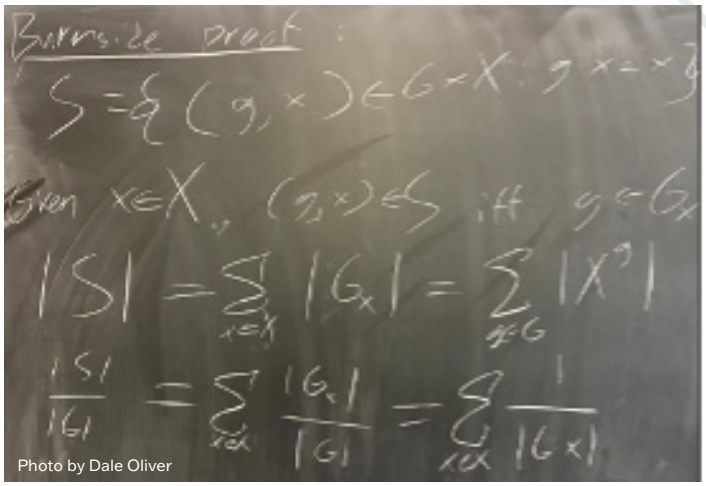
Advanced Studies Spotlight

Algebraic Combinatorics & Representation Theory - Dale Oliver

Professor Dale Oliver is facilitating a directed study for three theoretically minded students: **Desmond West-Hedlund**, **Kenji Hatchimonji**, and **Jacob Barth**. The students are studying Algebraic Combinatorics through Richard P. Stanley's advanced undergraduate text of the same title. These students have shown impressive ability to grasp new notation and mathematical objects, improve on proofs presented in the text, and tackle challenging problems. Professor Oliver attends their sessions and enjoys listening to their mathematical discourse. As the semester progresses, the directed study will advance to portions of a graduate text on Representation Theory, which forms the foundation of much Algebraic Combinatorics. Professor Oliver and other department faculty will be following the mathematical trajectory of these promising students with great interest.



The figure shows the Young diagram of the partially ordered set of partitions of non-negative integers with at most 2 parts and with largest part at most 3. The partially ordered set of partitions of non-negative integers with at most n parts and with largest part at most m have facinating properties.



Boardwork from a class section shows a streamlined proof of Burnside's Lemma.

Measure Theory - Walden Freedman

Measure Theory is a subject usually studied in the first year of a graduate program in mathematics. This Spring 2025 semester, Professor Freedman is running a Directed Study course on the subject with three undergraduate students: **Jacob Barth**, **Kenji Hatchimonji**, and **Desmond West-Hedlund**. The class is run in a relaxed way with a general discussion of the course topics, student presentations at the whiteboard, and a take-home midterm and take-home final exam. The textbook used is "Measure, Integral, and Probability," by Marek Capiński and Ekkehard Kopp, 2e, Springer, 2005.

Students typically learn about the Riemann (definite) integral in a Calculus I course, for example learning how to interpret and evaluate integrals of basic functions, and interpreting the results for non-negative continuous functions as areas under curves. But this type of integral is not defined for certain kinds of functions, such as functions with discontinuities at every rational number.

While measure theory is often studied in an abstract way, the directed study course focuses on the Lebesgue integral and measure on real number spaces, primarily in one dimension. The Lebesgue integral extends the Riemann integral, allowing integration of a much wider class of functions. For example, although the Riemann integral of certain highly discontinuous functions does not exist, the Lebesgue integral of such functions can still be defined. In fact, the Lebesgue integral is defined for a much wider set of functions, and it has more robust limiting properties than the Riemann integral, making it preferable in many cases.

The general theory of measure and integration encompasses the concept of infinite series, which students typically first study in Calculus II. One comes to understand that asking whether an infinite series is absolutely convergent is simply asking whether the corresponding function on the natural numbers is integrable with respect to the counting measure.

One reason the first year of graduate study includes measure theory is that it is required for further study such as functional analysis, where one studies normed (vector) spaces of integrable functions and their dual spaces.

Measure theory is a challenging subject even for graduate students in mathematics, but all three Humboldt undergraduate students enrolled in the directed study course are meeting that challenge admirably. By enrolling in a directed study course like this one, students can get a head start on graduate study and be better prepared to meet its challenges.

Scholarships & Prizes

Scholarships & Prizes - Tyler Evans

Each spring, the Mathematics Department at Cal Poly Humboldt celebrates student excellence through its annual scholarship program. In 2024, the department awarded a total of $17,500 in scholarships to deserving students who demonstrated outstanding academic achievement and dedication to the mathematical sciences.

Last year, these scholarships—established in memory of former professors, students, and friends of the department—were presented during the annual Scholarship and Awards Reception held on May 2. Each award recognizes not only academic merit but also other criteria specific to the scholarship's purpose and legacy.

The prestigious Harry S. Kieval Mathematics Scholarship, valued at $5000, was awarded to **Chase Loughmiller**. This significant award, established in 1983 by the late Professor Harry S. Kieval who taught at Humboldt from 1966 to 1979, recognizes the department's most outstanding senior-to-be mathematics major. Loughmiller also demonstrated excellence in mathematics competitions, taking first place in Category A of the Mu Alpha Theta Contest.

Three students—**Megan Pratt**, **Aaron Ramirez**, and **Natalie Winn**—received a $3000 Travis Jepsen Memorial Mathematics Scholarship. This scholarship was established in 2004 in memory of Travis Jepsen, a mathematics major at Humboldt until his untimely death in 2003. Aaron Ramirez has also taken on leadership responsibilities as the President of the Math Club.

The $1000 Latika Patel Scholarship was awarded to **Brielle Wilson**. Established in 2007 through the generosity of Professor Emeritus Vithalbai Patel and his wife Latika, this scholarship supports students pursuing a mathematics degree. Professor Patel taught at Humboldt from 1969 to 2004.

Natalie Winn received the Robert S. Chambers Scholarship of $1000, established in 2002 in honor of Robert S. Chambers, a friend of the department.

Eli Drohan was recognized with two scholarships: the Orval M. Klose Mathematics Scholarship ($500), established in 2003 in memory of Dr. Klose who served as a mathematics professor at Humboldt from 1958 to 1975, and the Harry S. Kieval Transfer Scholarship ($1000), which recognizes outstanding performance at a two-year college in preparation for transfer to Humboldt.

Many of these scholarship recipients were also active participants in the department's numerous mathematics competitions, including the Integration Bee, William Lowell Putnam Mathematical Competition, Mathematical Contest in Modeling, DataFest, CSU Research Competition, and Kaggle Competition. Their excellence in both academic achievement and competitive events demonstrates the vibrant mathematical community being fostered at Cal Poly Humboldt.

The Mathematics Department expressed gratitude to all donors and benefactors whose generosity makes these scholarships possible, supporting the next generation of mathematicians and data scientists. The department will continue this tradition with the 2025 Scholarship and Awards Reception scheduled for early May, after this newsletter goes to print. Look for information about our newest scholarship recipients in next year's newsletter.

2024 Harry S. Kieval Scholarship recipient Chase Loughmiller (left) with Dr. Evans.

2024 Jepsen Scholarship recipients Aaron Ramirez (left) and Natalie Winn (center) with Dr. Evans at the award ceremony.

Mathematics and Data Science students and faculty at the 2024 award ceremony.

Student Research Experiences

Student Researchers Tackle Neurodegeneration - Kamila Larripa

Five undergraduate students are working with Dr. Kamila Larripa on a project funded by the National Science Foundation Mathematical Biology program (Award Number 2245839). The project models the interaction of immune cells and neurons in the brain and seeks to understand specific mechanisms which lead to neurodegeneration. This year, the team is incorporating metabolic pathways into the model. **John Gerving**, **Martin Mendoza-Ceja**, **Abigail Penland**, **Megan Pratt** and **Cheyenne Ty** are the lab members, and will present their results at the CSU Research Competition in April. The lab group published their first paper in Spora: A Journal of Biomathematics and also presented at the American Physical Society Far West Conference in October, and will share their work at MathFest in Sacramento in Summer 2025.

Microglia Research Team Members: (left to right) Martin Mendoza-Ceja, Professor Kamila Larripa, Cheyenne Ty, Megan Pratt and John Gerving.

Learn By Doing: Building & Using a Super Computer - Ken Owens

Cal Poly Humboldt students are working after hours to build a new GPU-based supercomputer named Helios, which will consist of eight compute nodes. Each node uses two NVIDIA Tesla K80 graphics cards and dual CPUs.

Students have already configured 100Gbit ethernet cards for Helios' compute nodes, written distributed computing software, and configured the supercomputer cluster operating system. Recently, they configured two of the eight compute nodes to PXE boot over the 100Gbit ethernet switch utilizing DHCP and TFTP servers they installed on Helios' main system. In the future, they plan to expand Helios by installing eight NVMe drives for high-speed storage and adding six more compute nodes.

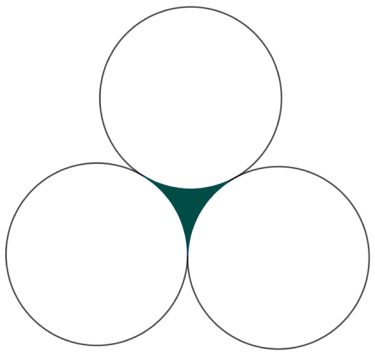
The Microglia Research Team was honored at this year's Cal Poly Humboldt Student Award ceremony in the Outstanding Student Researchers category. Pictured (left to right) are team members Megan Pratt, Cheyenne Ty, Abigail Penland, and Martin Mendoza-Ceja together with Cal Poly Humboldt Interim President Michael Spagna.

Students (left to right) Evan Woloszynek, Omar Chavez-Estrada, and Erick Herrera showing two compute nodes, server and 100Gbit switch of the Helios Supercomputer.

Puzzle Corner

The three circles shown here are congruent and tangent in pairs.

What is the area of the shaded region in terms of the circles' radius?



Puzzle solution on page 14.

Casting Mathematics Into Nature

What Does Mathematics Have To Do With Trout Fishing? - Rob Van Kirk

For those who do not know me, my history with Cal Poly Humboldt dates to when it was called Humboldt State College. I grew up two blocks from campus, graduated with a B.A. in Mathematics in 1984, and followed up with an M.S. in Environmental Systems (Mathematical Modeling) in 1990. As I was completing my Ph.D. in Mathematics at the University of Utah in 1994, I was hired as the first Research Director at the Henry's Fork Foundation (HFF), a nonprofit trout fisheries conservation organization in Idaho.

I got the position with HFF largely because I had firsthand knowledge of the Henry's Fork of the Snake River, having fished there since 1977. I convinced the hiring committee I could learn fisheries biology and aquatic ecology by sharing advice from Rollie Lamberson: with a mathematics background, I could become a researcher in any field of science.

After four years at HFF, I spent 14 years as a mathematics professor at Idaho State University and then Humboldt before returning to HFF in 2013, where I've been ever since.

What do we do, and how do we use mathematics?

In the arid American West, fisheries conservation is essentially water conservation. In the Snake River basin, over 90% of surface water is withdrawn for irrigation. Historically, much of that water seeped from leaky canals into the Eastern Snake Plain Aquifer, one of the world's largest aquifers. This not only provided water for groundwater-irrigated lands but enhanced downstream flow as groundwater returned to the river. This system worked well until farmers began replacing leaky infrastructure with modern pipes and sprinklers in the 1980s, reducing aquifer recharge.

In the 1990s, University of Idaho scientists began developing a mathematical model of groundwater-surface water interactions. With my background in partial differential equations, I helped develop "response functions" (equivalent to Green's functions in PDE solutions) that describe how inputs to or withdrawals from the aquifer affect groundwater outflows to the river over time.

A recent publication combines a stochastic water-operations model with aquifer response functions to assess managed aquifer recharge as a replacement for incidental recharge that occurred before irrigation modernization. We conducted 1000 stochastic replicates of a 30-year model with daily time steps.

The most computationally intensive part tracks the effect of water recharged to the aquifer, as effects take about 30 years to fully propagate through the system. However, the temporal component depends only on the time difference between recharge and response. We calculated the entire 30-year vector of daily responses using a single matrix multiplication with a lower-triangular matrix and a vector of daily recharge volumes, using R's Matrix package to keep run times under 8 hours.

Beyond PDEs, linear algebra, and stochastic processes, my colleagues and I routinely use dynamical systems, generalized linear models, and time-series methods to analyze everything from snowmelt timing to trout populations. We use custom R code to automate retrieval and processing of thousands of climate, hydrology, and water-quality data points daily and upload them to dashboards, online reports, and modeling tools that facilitate better water resource management. Two of our six-person team have mathematics backgrounds.

Rollie was right. I could never have imagined the different scientific disciplines I'd work in throughout my career, all made possible by academic training in mathematics and a passion for trout fishing.

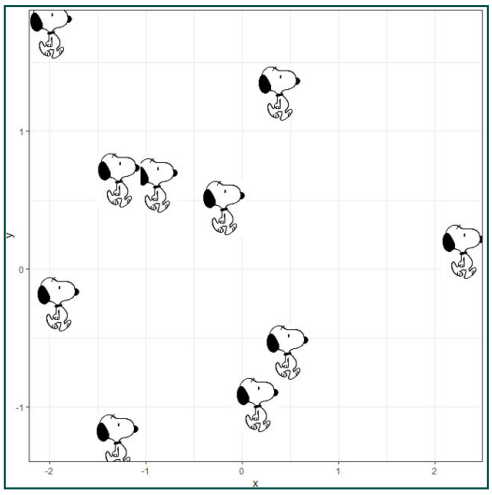
Top left: Dr. Rob Van Kirk, Science and Technology Director, Henry's Fork Foundation, Ashton, Idaho.

Above center: Scientists from the Henry's Fork Foundation measure streamflow.

THE VOICE OF THE RIVER
SINCE 1984
HENRY'S FORK
FOUNDATION

Got Data? We Can Help!

Professor Rosanna Overholser works at her laptop.


Sample R plot using a customized image as a plotting symbol.

Statistical Consulting Service - Yoon G. Kim

The Mathematics Department's Statistical Consulting Service has been a longstanding yet often overlooked resource on the Cal Poly Humboldt campus. Under the guidance of dedicated and experienced statistics instructors—including Professors Kim, Rizzardi, Overholser, and others—this valuable service has operated informally for many years.

Our consulting service supports graduate and undergraduate students, faculty, and local researchers with all aspects of statistical analysis. Whether you're just beginning your research journey or finalizing your analysis for publication, our experienced statisticians provide expert guidance throughout the process.

What We Offer:

- Free statistical analysis and advice for research projects at any level
- Assistance with data cleaning and preparation
- Software support (R, SAS, SPSS, Excel, Python, Minitab, C++, and more)
- Guidance on study design and appropriate methodologies
- One-on-one consultations and group sessions
- Help with interpreting findings and writing results sections

Why Choose Us?

- On-campus experts with years of experience who understand your challenges
- No cost to students and faculty
- Personalized assistance at every project stage
- Convenient campus location with flexible scheduling for in-person or virtual meetings

The sample plot shown above demonstrates how to use customized images as plotting symbols in R. The code example uses the ggplot2 and ggimage packages to create visually distinctive data visualizations:

```
library(ggplot2)
library(ggimage)
mydata <- data.frame(x = rnorm(10), y = rnorm(10),
  image = sample(c("G:\\STAT333\\snoopy.jpg"),size=10,replace=TRUE))
ggplot(mydata, aes(x, y)) + geom_image(aes(image=image), size=.05) + theme_bw()
```

For more information about the Statistical Consulting Service, contact Professor Yoon G. Kim at ygk1@humboldt.edu.

Matrix Factorizations & Physics

Factoring Via a Magic Square - Peter Goetz

I work in the area of mathematics broadly referred to as algebra, a field that extends the familiar operations of addition and multiplication we learn in school into more abstract and powerful frameworks.

I focus on special mathematical structures called rings, where addition and multiplication follow nearly all the rules we're used to—with one notable exception: sometimes the order of multiplication matters! Mathematicians call this property "noncommutative." For example, A and B could represent rotations in 3-dimensional space with A times B meaning "first do B, then do A". Most of the time, A times B will not be the same as B times A! Interestingly, such rotations are used in writing code for video games.

Sets of polynomials also form another very important class of rings. There are noncommutative generalizations called Artin-Schelter regular algebras, which can model certain problems in theories of quantum mechanics and quantum gravity. In recent work with Ellen Kirkman, Frank Moore (both from Wake Forest University), and Kent Vashaw (UCLA), I studied some of the geometric structures associated with 4-dimensional Artin-Schelter regular algebras.

This collaboration has sparked two exciting current projects. The first involves the general problem of computing the center (the part of a ring which is commutative) of group-graded Artin-Schelter regular algebras. The second project concerns noncommutative matrix factorizations for Artin-Schelter regular algebras. Matrix factorizations in this context have roots in quantum mechanics.

Physicist Paul Dirac photographed in 1929 at the University of Chicago.

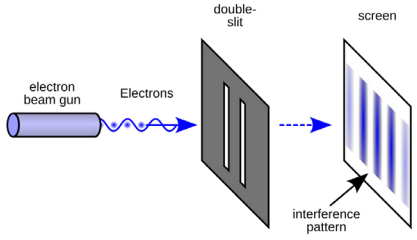
Photo: wikiquote.org.

This second project connects to groundbreaking work by physicist Paul Dirac, who in the early 20th century found a matrix-based "square root" of a fundamental operator in quantum mechanics. Today, physicists working to unite gravity and quantum mechanics are extending Dirac's approach. I recently developed a method to build noncommutative matrix factorizations over all Artin-Schelter regular algebras.

The key to this construction was proving what initially appeared to be an extremely complicated identity with potentially hundreds of terms. The breakthrough came through what I call the "magic square"—a compact mathematical diagram that elegantly demonstrates how the seemingly complex terms organize themselves perfectly.

This research not only advances pure mathematical theory but also provides tools that may help physicists develop a more complete understanding of our universe at its most fundamental level.

$$\begin{array}{ccc} V^* \otimes V^* \otimes V \otimes V & \xrightarrow{\mu_S \otimes \mu_A^!} & S_2 \otimes A_2^! \\ \downarrow{\scriptstyle \nu_1} & & \downarrow{\scriptstyle \nu_2} \\ \mathrm{Hom}(V^* \otimes V^*, V \otimes V) & \xrightarrow{\pi} & \mathrm{Hom}(I \oplus \mathbb{K}F, V^* \otimes V^*/I) \end{array}$$



Faculty Research

Tyler Evans

My research continues with Professor Alice Fialowski (Eötvös Loránd University, Budapest, Hungary) on problems in restricted Lie algebras. We recently published our sixth joint paper, "On the cohomology of restricted Heisenberg Lie algebras," which appeared in the journal *Linear Algebra and its Applications*. In this newest paper, we worked with Chinese mathematician Dr. Yong Yang, who was Professor Fialowski's PhD student. This research explores mathematical structures that are important in quantum mechanics, specifically examining certain algebraic properties of Heisenberg Lie algebras in fields of prime characteristic. Our work helps classify these structures and computes important invariants that describe their properties. I continue to visit Budapest regularly to collaborate directly with Professor Fialowski, combining mathematical research with opportunities to practice and improve my Hungarian language skills.

Bethany Johnson

My research focuses on developing data-driven methods for forecasting nonlinear dynamics and optimizing decision-making in ecological systems. I apply these methods to a range of applications, from pest management to sustainable agriculture. Recently, I published a paper in Ecological Modeling with collaborators from UC Santa Cruz on optimizing insect pest control strategies. Our goal is to reduce damage to crops and forests while minimizing reliance on chemical insecticides, which can have unintended ecological consequences. Another project, in collaboration with researchers from Woods Hole Oceanographic Institution, UC Santa Cruz, and UC Davis, explores forecasting regime shifts in ecological systems, such as abrupt population collapses. This work, currently under review at PNAS, aims to improve early warning systems for these critical transitions. In addition, I have started new collaborations with Ryzee Inc., AmHydro, and Auburn University to develop forecasting models for hydroponic agriculture. By predicting plant production in controlled environments, we hope to enhance efficiency and sustainability in food production.

Kamila Larripa

I was fortunate to work at Simons Laufer Mathematical Sciences Institute (SLMath) for part of summer 2024 with their research program. My collaborators Anca Radulescu and Deena Schmidt and I worked on modeling paradigms which incorporate the effects of human behavior on epidemic dynamics. SLMath is a wonderful and vibrant place for people who love mathematics to come together! I also continued to work on tensor regression problems in data science and submitted several manuscripts with collaborators this academic year. My main focus this year has been on modeling immune cell behavior and now incorporating metabolic pathways and understanding how metabolism impacts neurodegeneration. My lab group published a paper (with undergraduate student authors) in ***Spora: A Journal of Biomathematics*** (Vol. 11, 20–35), and my collaborator and I published a paper in the ***Journal of Theoretical Biology*** (Volumes 602–603, 7 April 2025, 112049). We are very thankful to the NSF for supporting this project. I am happy to be able to do this work, and I am looking forward to more research this coming year.

Rosanna Overholser

My main research interest is best practices for model selection and thinking carefully about how to use data to build a model for the purpose of explanation vs. prediction. It's hard to keep up with all advances being made in predictive modeling, i.e., Machine Learning and AI! In spring 2025, my husband Peter (who is a Research Scientist at Schatz Energy Research Center on campus) started a weekly group with other faculty, students, and staff to discuss tools in AI Systems Engineering. This being Cal Poly Humboldt, we are using the framework of "Appropriate Technology" to think about best practices for designing AI systems. This summer, I plan to travel to the Joint Statistical Meetings in Tennessee to present on "Teaching Causal Inference in Introductory Statistics and Beyond".

Ken Owens

I continue to develop a physics-based particle-in-cell simulation of burning plasmas. This simulation consists of modeling the plasma equations with MPI/CUDA code and running the model on Nvidia graphics cards in a supercomputer I built with students at Cal Poly Humboldt.

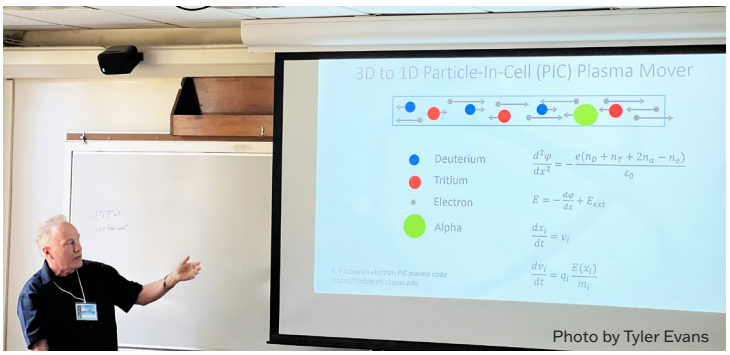


Photo by Tyler Evans

Professor Ken Owens presents his work on a 1-dimensional plasma model at the American Physics Society Far West conference held at Cal Poly Humboldt in October 2024.

Alumni Updates

Damien Adams (B.A. 2010)
I got my M.S. from San Jose State in Mathematics and secured a full-time teaching position at Cabrillo College in 2014. In 2017, my wife and I moved to Portland, OR, where I teach for Portland Community College, focusing on teaching Calculus and Linear Algebra and building community among my students. I also created a podcast called Women in Math: The Limit Does Not Exist. I value compassion and belonging in all facets of my life, and I am continuing to learn and embrace my Asian heritage.

Dr. Matt Darnall (B.A. 2004)
After graduating from Humboldt in 2004, I went to the University of Wisconsin-Madison and completed a Ph.D. in Mathematics under Nigel Boston. During my Ph.D., I spent the summers interning at Motorola / Credit Suisse and attending computational number theory workshops. After graduating, I knew I wanted to work at the intersection of math and programming, so I took a full time job at Credit Suisse as an Interest Rate quant. Since then, I have worked for several hedge funds and am currently the Head of Development for a Macro hedge fund. Outside of work, my wife and I fostered five children and currently have two children at home in White Plains, NY.

Charlin Duff (B.A. 2023)
After graduating in spring 2023, I took a break from math and worked as an administrative assistant while contemplating which career path I wanted to pursue. I discovered that I really enjoy data science. Using mathematics, programming, and creativity to provide tangible solutions to abstract questions gives me a deep sense of satisfaction. For the past year, I have been working as a data analyst for a small company, and I love it! Moving forward, I want to dive deeper into the applications of data science, particularly in predictive analytics and how it can be used to support industries and causes I care about. This fall, I plan to start an M.S. Statistics program to help me achieve my goals. I currently live in the Bay Area, but I still visit Humboldt occasionally to see friends and spend time among the redwoods.

Dr. Jeremy Johnson (B.A. 2018)
I completed my Ph.D. in Mathematics at the University of Wisconsin-Madison in December of 2024, where I studied various matrix problems including pattern-avoiding (0,1)-matrices and matrix completion. I will be living in Bristol, UK with my wife and dog for the next three years. Career-wise, I am currently trying to break into low-level systems programming. I continue to think about 312-avoiding (0,1)-matrices and some geometric structures associated with them in my free time.

Ana Sammel (B.A. 2022)
I am currently in my 3rd year at UC Davis in the applied math Ph.D. program. I work with Martin Fraas in the Quantum Math and Physics group. We are studying adiabatic theory using asymptotic expansions. I recently passed my preliminary exams and am now focusing on preparing for my qualifying exam. I have enjoyed TAing in the department and teaching my first class last summer and am looking forward to teaching more in the future!

Jennifer Sorkin (B.A. 2003)
I am currently living in Denver, CO with my partner and two grey kitties. I've been working for a company that supports Cost Analysis/Data Science for large-scale Federal Government projects (primarily Defense contracts) for the last 20 years. I received my Masters in Math from UCSB back in 2005, after which I began immediately working in industry, for my current company. I'm proud to say that I've actually found a career that utilizes my extensive Math education, although I've found that additional applied Math courses would have been beneficial in my field. In my free time, I enjoy going to concerts and, when Denver's weather permits, gardening.

Dr. Michael Stobb (B.A. 2010, M.S. 2013)
After leaving Humboldt in 2013, I pursued a Ph.D. in Applied Mathematics at UC Merced, graduating in 2019. I immediately joined the faculty at Coe College in Cedar Rapids, Iowa, as a tenure-track professor in the Math and Computer Science Department. My first few years have been quite busy! I spearheaded the development and launch of a new Data Science program, which is experiencing healthy growth. My research time is primarily focused on Uncertainty Quantification, along with exploring effective approaches and practical applications for AI models.

Dr. Michael Wilson (B.A. 2019)
After graduating from the math department at Humboldt, I did a summer internship at NIH, where I contributed to research involving PET imaging data of cardiovascular disease. I then went on to Florida State University Department of Statistics where I obtained a Ph.D. My research involved Statistical Shape Analysis and Optimal Transport, with applications to video recordings of nanoparticle manufacturing processes and to the statistical analysis of Diffusion Tensor MRI images. The mathematics education I received at HSU proved very useful in my graduate statistics coursework, and the many opportunities I had for applied work through Bori Mazzag sparked an interest for analyzing imaging, in particular neuroimaging, data that followed through to some of the work in my dissertation,

...continued on page 14

Alumni Updates

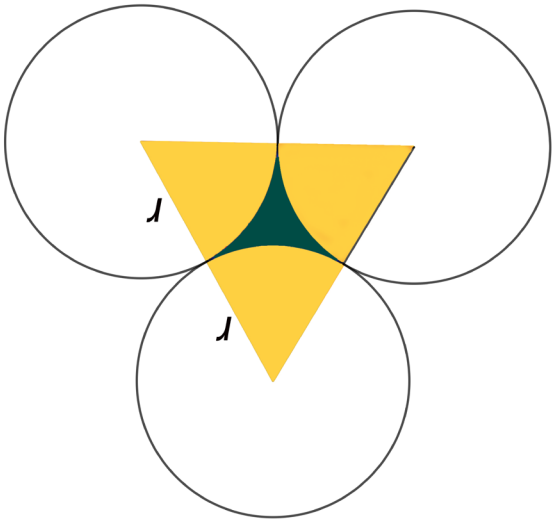
and an independent study course provided by Dr. Haag on Principal Component Analysis proved incredibly useful throughout my graduate studies. After graduating from FSU, I began working at Systems Planning and Analysis, a defense contractor in northern Virginia.

Drake Woosley (B.A. 2022)

After graduating in Spring 2022, I went to Western Washington University for their master's degree program in mathematics. For my final project, I studied Fourier analysis with a focus on the Fourier transform and Heisenberg's uncertainty principle. I received my M.S. in Spring 2024, and I am now in my first year of the mathematics Ph.D. program at Virginia Tech. Besides taking more courses in analysis and differential equations, I have been learning about mathematical quantum statistical mechanics and 2D materials, with a plan to focus on one of these topics for my research.

Puzzle Solution

The triangle is equilateral with side length $s = 2r$ and hence has area $\sqrt{3}r^2$. Together, the three yellow sectors have area equal to that of half a circle of radius r so the desired area is $A = (\sqrt{3} - \pi/2)r^2$.



Emeriti Updates

Phyllis Chinn

I am getting ready to move to Brooklyn, New York with my husband, Daryl Chinn, to be close to our children and grandchildren. We will miss all our friends as well as the great weather in Arcata.

Jeff Haag

I am semi-retired and I still teach in the fall semester. It's gratifying to maintain contact with students and colleagues, and it's exciting to be winding up my career as Humboldt establishes itself as a polytechnic institution. When I am not teaching I have other passionate pursuits, especially running, skiing, softball, and whitewater boating. Last year I ran my first ultramarathon, skied 30 days, and played on three softball teams, but did not get out on the river! I will rectify that this summer. If anyone reading this newsletter would like to get together for any of these or related activities, or just to say hello, please reach out. It would be great to hear from you.

Rollie Lamberson

I am not doing any serious mathematics but I try to keep up with some of the environmental and ecological issues that I worked on when I was active. I build furniture, most of which is auctioned off to raise money for charities, but frequently my children and grandchildren have ideas for pieces they would like to have me make. We continue to spend the fall each year at our Nebraska ranch. We also do a lot of traveling; Mexico and Costa Rica in the next few months.

Howard Stauffer

Rebecca and I are still traveling, to Paris, London, and Vienna in May and the Oregon Bach Festival in July, visiting our daughter Sarah in Eugene. Our son Noah and girlfriend Marisa and her 11 year old son Evan have returned from Oregon and live with us next door on our property. We enjoy grandparenting Evan with jazz piano and school. Rebecca has converted our property into a neighborhood garden with orchard, native plants, and dog sniffspot. I still have rotary projects, now in Pakistan and Kenya, and jam with my jazz trio. Life, except for national politics, is good!

Lourdes Triana

I am busy with a conversational Italian group and Sign Language classes. I also play the piano occasionally. Every so often I pick up a math book and try to work through some problems just to keep my brain active. I miss PreCalc, so I work on that book quite a bit, along with some math puzzles. I'm currently reading "The Heart of Mathematics" by Burger and Starbird—it's quite interesting. I recently married a man who speaks only English and am trying to convert him to being bilingual. He is resisting.

Cal Poly Humboldt
H. Mathematics

Farewell To A Legend!

Greetings and farewell fellow math and computer folks. I have been mulling over how best to write this letter and say goodbye. So much of my identity has been wrapped up in teaching math at Humboldt for the last 30 plus years (counting graduate school) that I admit it will be a shock to stop. Retirement will probably feel like a summer vacation that goes on and on, which does not sound bad right now!

There is a sense of mission in upholding standards that we all take on in teaching any STEM curricula. I was glad to have this sense of purpose in my life and to share it with other like-minded instructors. I always felt that the morale in the math department was high without any tension or infighting. If there were any conflicts thanks for keeping them hidden. Kudos to all for keeping the day calm and professional.

For me the work of teaching math was about presenting the material in a digestible format that runs parallel to what the student will see in their homework, quizzes and exams. Just as important is fast feedback. There is a shelf life of concern that a student has about how well they did on a particular quiz or exam. Their concern fades with a shrug after just a few days. But if one can get feedback in their hands right away, there is a strong chance of keeping the student engaged. With the immediacy of the result, they want to know whether they "got it" or if they didn't, where they went wrong. I recall a homework assignment on sign analyses that Tim Lauck and I used in our Math 105 courses that illustrates this point. Tim Lauck's programming skills in Python and LaTeX that made it all possible. The assignment prompted students with randomized derivative functions so that the parent function could not be determined, and they could not copy from each other. They had to apply the product, quotient and chain rules to determine the second derivative and then use a sign analysis for each derivative to determine the concavity and direction the parent function took in the graph plane. When the students turned in this assignment we would hand each of them immediate feedback on their randomized problem set. I was inspired to create more of these types of assignments, but it is a daunting amount of work to produce such assignments. It is now for me to stop and walk away. I wish you all the best in the coming years! - Tim

Commencement 2024

Photo by Elliott Portillo

Photo by Tyler Evans

Photo by Tyler Evans

Photo by Tyler Evans

H.

Thank You For Your Support!

Humboldt Mathematics has a strong sense of community, and the many donors who help support our efforts are an important part of that community.

To ensure students continue receiving the highest-quality mathematics education possible, we recommend three key areas where donors can make the greatest impact:

Learning by doing, which is critical in preparing students for their careers by taking education beyond the classroom where they can apply their learning in a real-world setting. Examples of learning by doing include participating in the MCM mathematical modeling contest and participating in DataFest.

Student research, which is a valuable experience for students pursuing competitive jobs and post-graduate programs in the sciences. There are several ways, such as covering travel and equipment expenses, in which donors can help.

Scholarships, which, based on need or a combination of other criteria, support students with financial resources to pursue their dreams.

With your support in these key areas, our students will have the experiences they need to learn, grow, and help create a more sustainable future for our planet.

Whether it is special learning opportunities like contests or conferences, access to new technologies, labs, or improved facilities, donors like you have the power to enrich the student experience at Cal Poly Humboldt.

To learn more about giving visit https://www.humboldt.edu/mathematics/giving or call (707) 826-5200.

Alumni - Drop Us A Line!

If you graduated with a mathematics degree from Humboldt, we would love to hear from you! Send an email to math@humboldt.edu and let us know what you're up to. Next year's newsletter will have a column with updates from alumni, and we would love to include you! You can also submit an update online at https://now.humboldt.edu/node/add/alumni_updates. If you would like to be featured on our department website, you can submit your information at https://www.humboldt.edu/new-alumni-profile.

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Cal Poly Humboldt Mathematics Department Newsletter - Spring 2025

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Written by: Brad Ballinger, Chris Dugaw, Tyler Evans, Walden Freedman, Peter Goetz, Bethany Johnson, Yoon Kim, Kamila Larripa, Dale Oliver, Rosanna Overholser, Ken Owens, Mark Rizzardi and Rob Van Kirk

Photos by: Kellie Brown, Tyler Evans, Yoon Kim, Dale Oliver, Ken Owens and Elliott Portillo

Layout and design by: Tyler Evans