

**FEMMES 2019 Capstone Event**  
Saturday, February 23, 2019  
8:45AM - 4:15PM  
Duke University, West Campus

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## **About FEMMES**

### **Our Mission**

The existing gender disparities in the STEM (science, technology, engineering, and math) fields underscore the need for outreach programs to help engage young women in such areas. Founded in 2006 by Vicki Weston, FEMMES (Females Excelling More in Math, Engineering and Science) is a student-led organization at Duke University that hosts educational outreach programs related to math, science, and engineering for 4<sup>th</sup>-6<sup>th</sup> grade girls from underserved areas in the Triangle.

## **Our Philosophy**

By incorporating engaging, hands-on activities into all of our programs, we allow the girls to learn in a fun, supportive environment and explore their potential in the STEM fields. We hope to build our participants' confidence in their academic skills and to empower them to pursue their dreams. Many of our students' parents and teachers have told us that after attending FEMMES, the girls become more motivated, participate more in class, and show a greater interest in school. The real power of our program lies in the way we use female role models to demonstrate how women can and do excel in these fields. In all components of FEMMES, female students and faculty members volunteer their time to instill enthusiasm about their careers in the developing minds of young women. Through the years, our volunteers have developed personal relationships with the participants and have had a positive influence on their attitudes towards STEM fields. Our programs provide excellent opportunities for female faculty and students to serve as role models and provide mentorship.

## **Our Programs**

The FEMMES organization seeks to improve female participation in STEM subjects with three main components: an annual one-day capstone event, an after-school program, and a summer camp program.

### ***Capstone Event***

The capstone event at Duke University is held each spring. This year will be the 14<sup>th</sup> annual FEMMES Capstone at Duke. The University of North Carolina-Chapel Hill FEMMES chapter held their inaugural capstone event in Fall 2009, and a newer chapter at the University of Chicago held their first in February 2015. The capstone event is a free program held on a Saturday from 9:00AM-4:00PM for 4<sup>th</sup>-6<sup>th</sup> grade students in the Durham area. This year, we will be hosting close to 300 girls at Duke. The day includes a keynote speaker who explains her role in her particular STEM fields and the path that led her to that role, followed by two morning activities, lunch, two afternoon activities, and closing remarks. Each hands-on activity is designed and led by female faculty members, female graduate students, and STEM undergraduate female organizations. Participants are placed in groups of 12-15 girls led by 2-3 undergraduate or graduate student volunteers who guide the participants through four different activities held in the engineering, science, math, and laboratory buildings on campus. As an assessment of our program, surveys are given to the participants prior to, on the day of, and six weeks after the capstone event.

### ***After-School Program***

Despite the success of the capstone event, we understand the need for continuous outreach in order to maintain interest in STEM. Studies have shown that while one-day events produce great short-term effects on interest and confidence, they may not last long enough to really influence a child's drive and ambition. For this reason, the FEMMES concept was expanded in Spring 2008 to an after-school mentorship program that fosters long-term relationships and constant encouragement. This mentorship opportunity invites 4th-6th grade girls to learn from Duke students for six weeks per semester at select elementary schools in the Durham area. Student volunteers travel to several Durham schools throughout the week to lead activities that expose girls to more applications of science, engineering, and math and to teach fundamental concepts in an engaging, hands-on manner. Some activities that we have done in the past include designing egg-drop parachutes and trebuchets (Physics and Engineering), performing ink chromatography (Chemistry), and making respiratory system models (Biology). An after-school committee meets throughout the year to design activities for the curriculum, acquire materials, and train the

volunteers ahead of time so that all activities run smoothly.

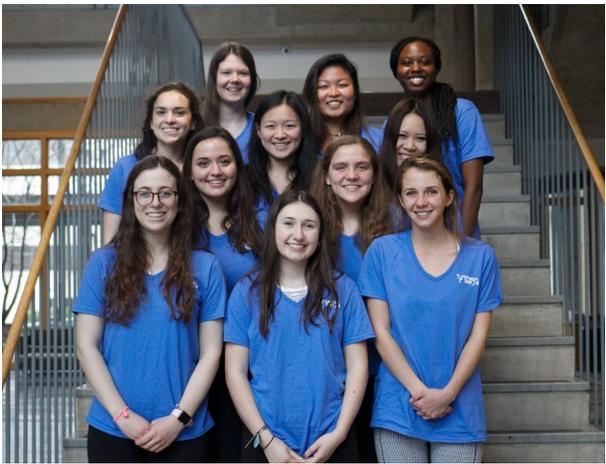
### ***Saturday Program***

In addition to our weekday after-school program, we decided to add a six-week Saturday series in Fall 2009. The Saturday series, held on Duke's West Campus, integrates activities that parallel the ones we plan for the after-school program. However, instead of going to the elementary schools during the week, we invite 100 4th-6th graders to Duke to do the activities. This way, we are able to reach out to other young girls who do not attend the elementary schools with whom we have partnered with for our after-school program. We plan to continue the Saturday series as a vital component of our after-school program.

### ***Summer Camp***

This past August, FEMMES also held its eighth week-long summer day camp at Duke for almost 100 5th-6th grade Durham girls. Duke University undergraduate and graduate females served as both counselors and mentors. Our theme was "Outer Space", and we incorporated fun hands-on activities, such as building mini rockets, coding and constructing robots, and making Nebula jars. In addition, participants were introduced to other exciting STEM concepts such as growing plants, designing a vehicle to safely drop an egg in, and making slime. We had the pleasure of being spoken to by many accomplished female faculty members, including Dr. Rebecca Simmons and Dr. Susan Rodgers. The camp was a huge success, and we are hoping to continuing this summer camp program as a long-standing component of FEMMES.

## Photos from Capstone 2018 Activities



# **SCHEDULE**

**Saturday, February 23, 2019**

8:15-8:45 a.m. – Students arrive, meet groups, get schedules and tote bags

8:45-9:00 a.m. – Travel to Love Auditorium

9:00-9:35 a.m. – Welcome speeches

9:35-10:00 a.m. – Break off into groups and travel to first activity

10:00-10:45 a.m. – Activity 1

10:45-11:00 a.m. – Travel to second activity

11:00-11:45 a.m. – Activity 2

11:45-12:00 p.m. – Travel to lunch

12:00-12:45 p.m. – Lunch

12:45-1:00 p.m. – Travel to third activity

1:00-1:45 p.m. – Activity 3

1:45-2:00 p.m. – Travel to fourth activity

2:00-2:45 p.m. – Activity 4

2:45-3:05 p.m. – Completion of evaluations/questionnaires

3:05-3:20 p.m. – Return to Love Auditorium

3:20-3:50 p.m. – Closing remarks and raffle

4:00-4:45 p.m. – Pickup by parents/guardians

## **Activity Descriptions and Faculty Biographies**

**Keynote Speaker: Sheila Patek, Ph.D.**



Patek received her A.B. with honors in Biology from Harvard University followed by a Ph.D. in Biology from Duke University. She was then awarded a Miller Postdoctoral Fellowship at UC Berkeley. She has received several honors, including a Guggenheim Fellowship, the George A. Bartholomew Award for distinguished contributions to comparative physiology, a Radcliffe Fellowship, a NSF CAREER award, and the Brilliant 10 award from Popular Science magazine. Her research has been funded by the National Science Foundation, National Geographic Society, Hellman Family Foundation, Armstrong Fund for Science, Department of Defense, and others. Patek currently leads a Multidisciplinary University Research Initiative (MURI) funded by the Army Research Office. She serves as Monitoring Editor for the Journal of Experimental Biology and Associate Editor for the journal Evolution. She is Director of the Physical Biology of Organisms consortium as well as for the program Matching Undergraduates to Science and Engineering Research (MUSER). Patek is Chair of the Biomechanics Division at the Society for Integrative and Comparative Biology. In addition to training graduate and postdoctoral scientists, Patek teaches undergraduate and graduate courses in animal physiology, biomechanics, introductory biology, invertebrate biology and comparative analysis. Patek has led an NSF-funded Research Experience for Teachers program for five years which enables teachers to integrate their research experience with curriculum development. The Patek Lab involves high school students and undergraduate summer researchers from around the country through fellowship programs, such as the Army Educational Outreach Program. Patek regularly presents her research internationally, through both academic and public lectureships - including a mainstage TED talk. The lab's research has been featured in hundreds of media outlets, including the New York Times, National Public Radio (NPR), Canadian Broadcasting Corp (CBC), British Broadcasting Corp (BBC), National Geographic and others.

***Anna Knight/Duke Ultrasound, Kathy Nightingale Lab***  
***“Exploring Ultrasound Imaging”***

Students will learn about the basics of ultrasound and medical imaging as well as get first hand experience with clinical ultrasound scanners and identifying structures on B-mode ultrasound image.

The goals of our laboratory are to investigate and improve ultrasonic imaging methods for clinically-relevant problems. We do this through theoretical, experimental, and simulation methods.

***Corrine Nief, Ramanujam Lab***  
***“Using Science to Zap Cancer Cells”***

Students will begin the activity by learning about what makes cancer cells different from healthy cells. They will also discuss how new cancer therapies must be safe for the healthy cells and must kill the cancer cells at the same time. Students will look at mouse cancer cells with a microscope. In teams students will compete to kill the most cells with the smallest amount of ethanol. Students will learn about microscopes, cancer biology, cell biology, and drug delivery.

We are Ph.D. Students in Nimmi Ramanujam's lab. We study how to diagnose and treat cancer. We specifically focus on cancer's that disproportionately affect women. Our lab tries to find unique and simple ways to detect and kill cancer. A current project we are working on is using ethanol to kill cancer cells.

**Duke Chemistry Outreach**  
**"Color Changing Materials"**

This activity will involve hands-on investigations of materials that will change color when exposed to a variety of stimuli such as heat/cold or light.

Duke Chemistry Outreach has been in operation for 14 years bringing STEAM activities to audiences of all ages who reside in the surrounding communities.

**Emily Klein with graduate assistants Erin Benson, Rachel Coyte and Alex Niebergall**  
**"Marvelous Minerals"**

Minerals are the building blocks of the Earth. They are found in everything from toothpaste, to paint, to cell phones. Working in small groups, students will learn to perform basic hands-on tests to distinguish different minerals from one another, and discover how minerals are important in our everyday lives.

Emily Klein is a geologist who studies volcanoes on the ocean floor. Her work takes her out to sea on research ships, where she uses small submarines or remotely operated vehicles to collect lavas samples from volcanoes on the ocean floor. In her laboratory at Duke, she analyzes the chemical composition of these rocks to understand how these volcanoes form.

**Rebecca Simmons**  
**"Innovation and Design in Engineering"**

The design process will be explored by working through a design challenge. Students will be challenged with creating an innovative and effective small watercraft. Students will brainstorm and sketch ideas, build a few quick prototypes, and then test their final design.

Rebecca Simmons, assistant professor of the practice. I teach freshman and junior design classes in mechanical engineering.

**Hsu-Kim Environmental Engineering Group**  
**"Tales of H<sub>2</sub>O: From Floccs to Filters"**

Where does our tap water come from? How does it get cleaned? Our drinking water comes from local streams, lakes, and underground water wells. But before the water makes its way to our faucets, environmental engineers first treat and purify the water to make it safe for people to drink. In this workshop activity, we will learn water treatment and filtration methods used by our drinking water treatment facilities. We will test different filter designs and observe which design is the most successful.

Dr. Hsu-Kim is an environmental engineer who studies pollutants in the environment. In her research she studies the chemical behavior of toxic metals in water and soil. Her group uses this information to develop technologies to clean soil and water. Additional details can be found on her webpage <http://hsukim.pratt.duke.edu>.

**Girls Engineering Change**  
**"Building Kits with GEC"**

Girls work hands-on with electric circuit boards to build everyday gadgets that will then be donated!

GEC is a non-profit organization that seeks to reduce gender stigma within STEM fields, specifically engineering. By working with young girls, we hope to foster their natural love for problem solving and creativity!

**Duke Women in Technology**  
**"Hour of Code"**

An introduction to computer science where students will learn computing basics through fun activities!

Women in Technology (WiT) is an undergraduate organization at Duke University dedicated to supporting women in technology. We aim to build and strengthen a supportive community for women in computer science and engineering, provide educational and professional opportunities, and raise awareness around the issues underrepresented groups in the field face.

**MGM Outreach**  
**"Microbes!"**

Life is about to get a lot... smaller. By the end of your time at "Microbes!", you will know whether microbes are friends or foes, name them without a reference book, and even get to see some yourself (with the help of a microscope, of course)!

MGM Outreach is a group of graduate students from the Molecular Genetics and Microbiology department. Our mission is to include the greater Triangle area in the exciting field of microbial science and to connect with anyone interested in learning more about STEM fields.

**Elizabeth Bucholz**  
**"Visible Light Computed Tomography"**

Have you ever wondered how Computed Tomography works? Wonder no longer! Participants will get to see for themselves how CT works by performing a visible light CT on blocks, then they will get to see a computer simulation to see what it would look like with Xrays!

Dr. Bucholz is the Associate Director of Undergraduate Studies for the department of biomedical engineering at Duke and she loves to be creative with how she teaches new concepts. She lives with her husband and 3 adorable children in Cary, NC.

**Clementina Davenport, PhD and Clarissa Diamantidis, MD, MHS**  
**“Coins, Beans, Birthdays and Statistics!”**

In this activity, students will learn how to use statistics to solve everyday problems. Through hands on experiments, students will learn how to organize the results of a probability experiment in a frequency table using the flip of a coin, understand how sampling influences data estimation using jars filled with beans, and perform their own statistical experiment using only their senses of taste and sight!

Clementina Davenport is a Biostatistician III and Course Director in the Duke Department of Biostatistics and Bioinformatics. She collaborates with researchers and nephrologists investigating factors that may explain racial disparities in poor health outcomes, primarily in kidney disease, but also in diabetes, hypertension, cardiovascular disease, and teaches a graduate level biostatistics course. Clarissa Diamantidis is an Assistant Professor of Medicine in the Duke Divisions of General Internal Medicine and Nephrology. She is a renal epidemiologist conducting research examining factors related to disparities in kidney disease health and testing the effectiveness of low-literacy digital interventions to improve care engagement by high risk populations.

**Nina Sherwood, *The Fly and I***  
**“The Fly and I: How we can use fruit flies to learn more about ourselves!”**

How similar do you think you are to those little flies you see buzzing around your fruit? Do they have a brain? Feelings? Do they sleep? Groom? Fight? Get sick? In this workshop we will learn how the tiny fruit fly can teach us about how our own bodies work. We will look at a variety of flies, observing their physical traits using the microscope and a few of their behaviors, and then identify mutants in these traits or behaviors from a set of “mystery” flies. You’ll be amazed by what can happen when a single gene – one that you may have too – has a mistake in it!

Dr. Sherwood has been a professor at Duke for 14 years, and loves animals of all kinds (from flies to furry critters to humans), cells (especially neurons), and learning new things. Dr. Ozdowski also teaches and does research in the Biology Department at Duke. She loves fruit flies, genetics, learning how animals develop, and how we can use basic science to improve human health. Briana Davis is a first year graduate student in the Cell and Molecular Biology program at Duke. When not in lab, she can be found cheering at the home basketball games, hanging out with friends at the mall, or reading a good book.

**Duke Flash!**  
**“Circuits!”**

Students will do a fun and short circuits activity!

Duke Flash! is an organization dedicated to spreading hands-on engineering experience to underserved populations. Through projects like building a flashlight, we foster curiosity and confidence in students.

**Miranda Shipman, Meredith Achey, Victoria Hall, Tal Greber, Neuroscience - Synaptic Plasticity Group**  
**"Synaptic Tag"**

Learn all about the brain and then explore how your brain learns, then do it yourself!

The Neuroscience - Synaptic Plasticity Group are members of the Calakos Lab at Duke. We are a synaptic plasticity lab and focus specifically on the striatal circuits of the basal ganglia. This allows us to look at a wide range of disorders from Parkinson's, OCD, Dystonia, Huntington's and Tourette's Syndrome.

**Hargrove Lab**  
**"DNA: Understanding What Makes You Unique!"**

In this fun-filled session, participants will build a life size model of DNA, extract DNA from a strawberry, visualize DNA using a microscope, and make a unique "MY DNA" bracelet.

The Hargrove lab is an interdisciplinary team that works at the interface of chemistry and biology, using organic chemistry tools to study the structure and function of long noncoding RNAs.

**Ziva Meyer**  
**"Constructing Different Geometries"**

Solely by using paper cutouts of pentagons, hexagons, and heptagons we can discover properties of differently curved surfaces! We'll start by tiling the familiar Euclidean plane with hexagons and discussing what we know about parallel lines and triangles. After that we will try switching out polygons to construct surfaces with positive and negative curvature. With models in hand we can then begin exploring properties of lines, parallel lines, and triangles on surfaces that aren't flat. This activity was developed by Samantha Pezzimenti, who received her PhD in mathematics in 2018, who based it off of an exercise in Daina Taimina's "Crocheting Adventures with Hyperbolic Planes," and is used with permission.

Ziva Myer is an Assistant Research Professor in the Duke University Mathematics Department. She received her PhD in math from Bryn Mawr College in May 2017 and her BA in math/physics from New College of Florida in 2011. Her research interests lie in the fields of contact and symplectic geometry and low-dimensional topology. Orsola Capovilla-Searle is a PhD candidate in the Duke University Mathematics Department studying contact and symplectic geometry. Nicole Crumpler is an undergraduate student at Duke studying physics and mathematics.

**Susan Rodger**  
**"Creating a 3D Interactive Story"**

Participants will be introduced to computer science by learning some basic programming concepts to create a 3-D interactive animation. Using the programming environment Alice, they will first select 3D objects from a library and place them into a virtual world. They will then learn how to program the objects to move, talk and interact. Next they will learn how to create events so they can interact with objects. For example, pressing the "j" key will make a bunny jump. Participants will then learn how to combine these elements together to write a short interactive story.

Susan Rodger is a Professor of the Practice in the Computer Science Department at Duke University. She completed her PhD in Computer Science at Purdue University and has been a professor at Duke since 1994. Her research interests include creating interactive and visual software for teaching computer science, and computer science education. One project, Adventures in Alice Programming, looks at integrating computer science into middle schools and high schools. She has organized four Alice Symposiums and over fifty workshops on Alice, JFLAP, Peer-led Team learning, career mentoring for faculty, and other computer science education topics. She has supervised over eighty-five undergraduates and fifteen masters students in research projects and co-advised one Ph.D. student.

***Mikkelsen Lab***  
***"The Magic of Optics"***

Through hands-on activities we will explore optical phenomena such as light diffraction, interference, color, and polarization. Lenses and mirrors will be used to create optical illusions, for example making an object appear invisible by matching the index of refraction. Students will also observe light traveling within optical fibers or a water stream, illustrating total internal reflection, diffraction patterns and a rainbow formed in a cup of water.

Dr. Maiken H. Mikkelsen is an assistant professor in the Department of Electrical & Computer Engineering and the Department of Physics. Her research is focused on understanding properties of materials with nanoscale dimensions through their interaction with ultrafast laser pulses.

***Raynor/Surgery***  
***"Surgical techniques and ear anatomy"***

We will be learning to suture (sew) on pig's feet and learn to tie surgical knots. In addition we will learn about hearing and how the ear works. we will be able to examine each other's ears and listening to tuning forks to identify tones. we will be making keychains with surgical suture for taking home and practicing knot tying.

We are in the division of pediatric Head and Neck Surgery, department of Surgery and manage children who have ear, nose, throat, airway and neck problems. We treat children with medication and with surgery as indicated by their conditions.

***Donohue Lab***  
***"How organisms know what season it is, and why it matters" "***

Organisms sense all kinds of seasonal environmental cues, and those cues regulate when they hatch out (or for a plant, germinate), when they emerge from hibernation (leaf out), when they reproduce (flower and fruit), and die. In this activity, students will explore how organisms match their life cycle to the cycle of seasons, and what

the consequences are when they fail to match them. Students will learn about the different seasonal environmental cues that organisms use to time their life cycles, identify some of the consequences of not matching their life cycle to the seasonal environment and to the life cycles of other species, and learn why organisms are making mistakes in matching their life cycles to seasons under current climate conditions. They will be introduced to citizen-science activities that monitor the timing of biological events and shown how to participate in these scientific projects.

Kathleen Donohue is Professor of Biology at Duke University and Director of Graduate Studies in the University Program in Ecology. Professor Donohue's research focuses on how plants sense and respond to environments in ways that influence their development, fitness, population performance, and ranges. A single genotype can alter its phenotype in response to the environment, through the process of "phenotypic plasticity". We study environment-dependent phenotypic expression: what genetic, epigenetic, and developmental mechanisms enable environment-dependent phenotypes; what the adaptive significance of phenotypic plasticity is, and what its evolutionary and demographic consequences are.

Mariano Alvarez is a Post-Doc in the Donohue Lab. He studies ecological genomics and plasticity in plants.

Britany Morgan is a Graduate Student in the University Program in Ecology. She studies how epigenetic processes in plants permit information about the environment to be transmitted across generations, from parents to offspring, or even grandchildren. Environments experienced by parents often influence the traits that progeny (or even grandprogeny) express. She is interested in how this information is transmitted, how it induces different traits in offspring, and what the fitness consequence of those trans-generational environmental effects are.

Brandie Quarles is a Graduate Student in the Department of Biology. She is interested in how plants respond to environmental conditions to regulate their development and phenotypes, and how those responses influence the performance of plant populations. She studies how plants adapt genetically to different seasonal conditions and how population fragmentation and dispersal can alter the process of adaptation.

### **Victoria Akin** **"Tower of Hanoi"**

The classic game, Tower of Hanoi, is mathematically rich! It can be solved using the principle of mathematical induction. Students will build a model of the puzzle to experiment. Once we feel confident in our solution, we'll extend to more disks and see if we can find a pattern.

Victoria Akin is an Assistant Professor of the Practice in the Mathematics Department at Duke University. She started working at Duke in 2017 after getting her PhD in Mathematics from the University of Chicago.

### **Statistics** **"Visualize this!"**

In this activity students will visualize data about themselves. First, they will answer a series of questions using a Google Form (e.g. how much time they spend on their screens, sleeping, being physically active, going to homework, etc.). Then they will plot these data first using an interactive visualization app, and then writing code in R. The

exercises will be scaffolded such that each student can end up with at least one visualization they create regardless of their experience with computers.

Mine Çetinkaya-Rundel is Associate Professor of the Practice in the Department of Statistical Science. Mine's work focuses on innovation in statistics pedagogy, with an emphasis on computation, reproducible research, student-centered learning, and open-source education. Mine works on integrating computation into the undergraduate statistics curriculum, using reproducible research methodologies and analysis of real and complex datasets.

Maria Tackett is an Assistant Professor of the Practice in the Department of Statistical Science. Her work focuses on using statistical inference to interpret forensic evidence, specifically latent fingerprint evidence. In addition to her work in forensics, Maria studies how technology can be used to motivate students and enhance learning in introductory statistics courses.

Tori Ellison is a Teaching PostDoc in the Department of Statistical Science.

### **Neurogenesis** **"Inside Your Noggin"**

We will be using games and interactive activities to teach the girls about brain anatomy, neuron structure, and how they can get involved in research.

Neurogenesis is Duke's undergraduate neuroscience research journal. We publish work from undergraduate researchers across the country and spark intellectual discussions about neuroscientific topics.

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FEMMES would like to extend a special thanks to Duke University Stores, who generously donated \$100 worth of Duke-related items as door prizes for our participants. From Blue Devil magnets to lanyards, logo-shaped bracelets to Duke binders and folders, we know the girls will appreciate the prizes as much as we appreciate Duke University Stores' generosity.

FEMMES would also like to thank the University / Cultural Fund, Student Organization Finance Committee, Duke Partnership for Service, and the Lord / Alstadt Foundation for their generous support.