

# Carnegie Mellon University

Leonard Gelfand Center



**Rigorous - Educational - STEM Focused - Hands-on - Fun**

**Fall Saturday 2023 Series Classes - Carnegie Mellon University**

*Each class is \$55. Scholarship funds are available through gifts from several Carnegie Mellon alumni. Please see the information on page 7.*

## **ART IN MOTION, Grades K-2, November 4**

Discuss how things move and bring that knowledge to life! Create unique and individual paintings using the concept of motion. Can you move and manipulate the paint with a splat, bounce, spring, shake and push? Join us to find out! Art can get messy so please dress appropriately!



**Kathie Stilinovich** spent her childhood living in Brussels, Belgium and living up and down the California coast. She graduated from Pacific Oaks College in Pasadena with a Bachelor of Arts in Early Childhood Education and Development. She has over 30 years of experience working in the field as a teacher. She is the educational support staff for CMU's Children's School. Before moving to Pittsburgh, Kathie and her family lived in Boise, Idaho. They loved the small city to raise their two daughters. Once their girls left to pursue their dreams in other cities, Kathie and her husband decided they needed a new adventure on the other coast. They love Pittsburgh and all it has to offer. Kathie and her husband love to bike ride, walk their dogs, get coffee, and explore Pittsburgh.

## **BRAIN-BOTS, Grades 7-9, November 4**

How does the brain work to control your body? In this workshop you will have the opportunity to learn about the inner workings of the brain. We will discuss how our brains use electrical impulses to generate our thoughts, actions, and behavior with a focus on how the brain controls our muscles. The electrical signals the brain uses to control your body can even be used to control a robot! There will be hands-on activities to explore your awesome brain in action.



Megan

### **Megan McDonnell, Kendra Noneman, Emily Lopez, and Luz Andriano**

Megan, Emily, Kendra, and Luz are all Ph.D. students at Carnegie Mellon's Neuroscience Institute. As scientists, they research how the brain works to control the body and senses, with specialties in areas like vision, hearing, and motor skills. As part of the neuroscience programs at Carnegie Mellon, they serve as teaching assistants, as well as being involved in science-related outreach programs. One of their shared passions is bringing accessible science to kids, and to inspire more young minds to join STEM fields like neuroscience.



Luz



Emily



Kendra

### **BUG-BOTS, GRADES K-2, September 23**

Bounce your way into the exciting world of robots by exploring motion, power, and electricity. Discover the way motors and batteries operate. Discuss robots and bugs and then create a robot, explain how it moves, and take the robot home to share with your family and friends! Parents are invited to attend the Bug Bots parade at the end of class.



**Reed Luttmmer** is a third-year student at Carnegie Mellon University, majoring in Mathematical Sciences. They are a head teaching assistant within CMU's School of Computer Science, a research assistant for CMU's Infant Cognition Lab, and the community development chair of the CMU Math Club. Reed has worked in a variety of childcare settings, including as a tutor, quiz bowl coach, ski instructor, and most recently, a supervisor at an overnight camp for children with social, emotional, and behavioral challenges. In his free time, Reed enjoys reading, going for walks, playing quidditch, and spending time with his friends and family. Reed is passionate about sharing their love of STEM with others, and they are excited for this to be their third year working with the Leonard Gelfand Center.

### **BUILDING BLOCKS OF 3D PRINTING, Grades 3-5, November 4**

What do Legos, sandcastles, and 3D printing have in common? In this workshop, we will explore how building up layers of material forms the foundation behind 3D printing. Through building up parts using different materials and techniques, students will learn about novel manufacturing methods while working to achieve goals with their built parts.



**Alex Gourley** is a Ph.D. student in mechanical engineering working on additive manufacturing at CMU. He was born and raised in Iredell County, North Carolina. Alex went to Duke University and double majored in mechanical engineering and chemistry. While at Duke he played on the football team as a center for the offensive line. He was a member of the Duke Motorsports team and worked one summer for a NASCAR team. Outside of his studies, Alex enjoys playing video games, music, and woodworking.

### **BUILDING WITH STICKS AND STRAWS, Grades K-2, October 14**

Let your creative juices flow and build with items found around your house. We will discuss structures and shapes and then you will design your own structures. You will build a variety of structures using cardboard, pipe cleaners, bamboo skewers, toothpicks, tape, and straws. Caution, construction ahead! **Kathie Stilinovich** is the instructor for this class, see her bio on page 1.

### **CODING FOR BEGINNERS, Grades 2-4, September 23**

Have you ever wondered how computers make decisions? In this course we will learn how computers follow routines and instructions to complete a final task. Coding can seem like a lot of complicated numbers, so we will teach through fun activities where students perform everyday tasks to simulate how a computer 'thinks.' Kids will act as both a person instructing a computer, and as the computer interpreting its instructions. The purpose of this course is to introduce coding concepts with off-line instructional activities.



**Elsa Schleicher** is a senior at CMU studying Mechanical Engineering. She has previous experience as a Science Olympiad team coach for middle school students and has been a volunteer CAD/mechanical instructor for an upcoming FTC robotics team. In her free time, she enjoys reading, painting, and martial arts.

### COMPLEX FLUID TOYS, Grades 5-6, October 14

Is slime a liquid or a solid? What about a gummy worm? In this workshop we will explore the world of complex fluids, which are materials that aren't quite solids, but aren't quite liquids either! We'll learn all about the chemistry that makes these types of materials squishy and gooey, along with how chemical engineers use these materials to make products we use every day, including toys like silly putty and bouncy balls.



**Dr. Joanne Beckwith Maddock** is an assistant teaching professor in the Department of Chemical Engineering at Carnegie Mellon University. She earned her Ph.D. from the University of Michigan where she studied bacterial and fungal biofilms which are a common cause of medical device infections. She also worked as a manufacturing engineer at a company that makes paint pigment. Currently, she teaches Intro to Chemical Engineering, and the Chemical Engineering Lab courses. She is passionate about helping students understand the impact that chemical engineering has on their everyday lives and the wide range of job opportunities a degree in chemical engineering offers. When she is not teaching, you can find her going for a run or rock climbing.

### DIGITAL PHOTOGRAPHY, Grades 7-9, October 14

This class provides a first introduction to photography, optics, and imaging. We will begin by investigating properties of optical elements such as lenses, prisms, and filters, and see how we can use them to manipulate light. Then, we will go over how digital image sensors work, and take a look at the internals of a digital camera. We will use this background to understand the various settings (focus, zoom, exposure) and stages (optical, analog, digital) of the modern photography pipeline. In parallel, we will get hands-on experience with all these concepts using high-end digital cameras, including a photography competition at the end.



**Dr. Ioannis Gkioulekas** is an assistant professor at the Robotics Institute of Carnegie Mellon University, where he has been since 2017. Before that, he was a PhD student at Harvard University, and even before that an undergraduate student at the National Technical University of Athens, Greece. He works on computational imaging, which can be broadly described as coming up with systems that combine imaging (optics, sensors, illumination) and computation (physics-based modeling and rendering, inverse algorithms, learning) in innovative, unexpected, and meaningful ways. He is also more broadly interested in computer vision and computer graphics. He has received the Best Paper Award at CVPR 2019, the NSF CAREER Award, and the Sloan Research Fellowship.

### HOW 3D DISPLAYS WORK, Grades 6-8, November 4

3D movies and 3D AR/VR headsets are all the rage right now! But how do they work? This workshop investigates how we perceive depth and how displays can be engineered to "fool" the eye into seeing 3D. We will look at principles underlying glasses-enabled and glass-free 3D displays. You will also build your own 3D display as part of the workshop. **Students who sign up for this workshop need to bring a smartphone with them to class to construct their 3D displays.**



**Dr. Aswin Sankaranarayanan** is a professor in Electrical and Computer Engineering. He earned his Ph.D. from University of Maryland, College Park where he was awarded the distinguished dissertation fellowship for his thesis work by the ECE department in 2009. His research deals with understanding the interaction of light with materials, devising theories and imaging architectures to capture these interactions, and developing a deeper understanding of the world around us based on these interactions. His research identifies low-dimensional models for high-dimensional visual signals using both physics-based and learning-based formulations and develop imaging architectures and algorithms that exploit these low-dimensional models for efficient sensing and inference.

### **HOW ENGINEERS MAKE PLANES FLY**, Grades 3-5, *September 23*

Discover how planes fly and how engineers use Computational Fluid Dynamics (CFD) in plane design. Design your own wing and then test it in a “wind tunnel”. What shape will produce the best wing? What shapes produce no lift? Fly in to find the answers to these questions and more!



**Craig Weeks** is a PhD student in mechanical engineering working on computational fluid dynamics modeling of metal additive manufacturing processes. He is from Portland, Oregon and completed his undergraduate studies at Oregon State University, where he majored in mechanical engineering with a double minor in aerospace engineering and computer science. Craig was part of the hybrid and liquid-engine rocket teams at Oregon State, and interned at the NASA Glenn Research Center in Cleveland, OH working on electric aviation. In his free time, Craig enjoys trail running, playing piano and guitar, and discovering hikes in and around Pittsburgh.

### **IMAGING AND SINGLE PHOTONS**, Grades 7-9, *October 14*

This workshop will introduce a number of topics related to single-photon imaging and semiconductor devices for optoelectronic applications (gadgets that use light). For instance, students will be tasked to assemble light receiver systems that use components developed by Dr. Dandin and the PhD students in his lab. The educational outcomes of the workshop will be to introduce students to new concepts and the technological importance of novel light sensors and processing devices.



**Dr. Marc Dandin** is an Assistant Professor in the Department of Electrical and Computer Engineering at Carnegie Mellon University as of July 2019. He previously co-founded and led a start-up company in the medical diagnostics arena. Furthermore, he worked as a technical specialist in intellectual property matters at several law firms in the Washington, D.C., metropolitan area. For his research and entrepreneurship efforts, Dr. Dandin was awarded the University of Maryland Bioengineering department's *Robert E. Fischell Fellowship in Biomedical Engineering*, the Electrical Engineering department's inaugural *Jimmy H. C. Lin Award for Entrepreneurship*, and the Mechanical Engineering department's *Certificate of Excellence*. In 2017, he was elevated to the grade of Senior Member of the IEEE in recognition of his professional standing.

### **LET'S GET BUILDING**, Grades 3-5, *November 4*

The world around us is filled with towering skyscrapers and bridges spanning great distances. Have you ever wondered...how do they stand? How are they built? From simple sketches to the final product, these monumental tasks are achieved to stand proudly and beautifully through the collaboration between architects and engineers. This hands-on course begins with an exploration of the history, physics, and geometry of structures, before students test their own designs. How can designers balance the beauty of a building while still being structurally sound? Come build to find out!



**Charlie Hymowitz** is a third-year student at Carnegie Mellon University pursuing a Bachelors of Architecture with minors in Engineering and Sustainability. He is on the board for the CMU Freedom By Design chapter, a community service organization interested in engaging the Pittsburgh community through fabrication and design and is a teaching assistant within the School of Architecture. He has worked with the Leonard Gelfand Center from his first semester at CMU as both a Teaching Assistant and behind the scenes to help prepare workshops. He also previously taught K-12 courses at the Center for Architecture in NYC and at his local art museum. In his free time, you can find Charlie either running through the streets of Pittsburgh, pushing a buggy, or drawing for hours on end.

### **MARVELOUS MACROMOLECULES**, Grades 3-5, *October 14*

The existence of life is dependent upon nature's ability to manufacture very large, complicated molecules such as DNA and proteins. The ability of chemists to prepare really big molecules called polymers in the laboratory has revolutionized the manner in which we live. In this workshop, students will explore a variety of polymers, their usefulness, and how to make them in a manner which demonstrates care for the environment. This hands-on workshop will have students working in the lab and participating in lecture demonstrations to explore the amazing world of polymer chemistry.



**Dr. Gizelle A. Sherwood** is currently an Associate Teaching Professor at Carnegie Mellon University. She earned her Ph.D. in 2008 where her research focused on the effects of aggregation on the photo-physics of oligomers related to MEHPPV and CN-PPV. She primarily lectures Modern Chemistry, the sophomore year Analytical Chemistry labs as well as a Cosmetic Chemistry course. She is passionate about engaging students in discussion of the application of Chemistry to everyday life and has been involved in several outreach programs working with both the Boy Scouts of America and the Leonard Gelfand Center.

### **MATH TURNED INSIDE-OUT**, Grades 5-7, *September 23*

In this workshop students will be introduced to the basic ideas of topology, a field of mathematics that is becoming increasingly crucial to physics and engineering. It is the study of how spaces are organized and how they are structured and whether they can be smoothly deformed into each other or not. Through hands-on exercises, students will construct topologically inequivalent objects, like cylinders and moebius strips and examine them to discover and understand their difference.



**Dr. Shubhayu Chatterjee** joined the Department of Physics at Carnegie Mellon University as an Assistant Professor in January 2023. His research focuses on emergent phenomena in condensed matter physics and tries to understand novel behavior which results from the sheer scale and complexity of billions of interacting particles in everyday materials. He also studies how to use tools from the quantum information community to sense such emergent phenomena. Prior to joining CMU, he was a postdoctoral fellow at UC Berkeley. He received his PhD in Physics from Harvard University, and holds an integrated Masters in Physics from the Indian Institute of Technology Kanpur.

### **PERCEIVING THE WORLD THROUGH ROBOT SENSORS**, Grades 4-6, *November 4*

Which household chore would you like a robot to do for you? What does the robot need to know about its surroundings to perform that chore? We will explore different sensors and discover the various types of information that they provide. Learn about how robot sensors mimic human sensing capabilities and sometimes exceed them! Build a sensor-actuator loop that reacts to its environment. Learn how machine learning is making it easier for robots to perceive the world around them.



**Dr. Oliver Kroemer** is an assistant professor at the CMU Robotics Institute. His research interests are in machine learning and robotics, with a focus on learning for grasping and manipulation. Before joining CMU, Oliver was a postdoctoral researcher at the University of Southern California. He received his Master's and Bachelor's degrees in engineering from the University of Cambridge in 2008, and he defended his Ph.D. thesis at the Technische Universitaet Darmstadt in 2014.

### **SCALING AND SIMILITUDE, Grades 7-9, September 23**

Why is a 10-inch pizza typically more than double the price of a 6-inch pizza? Why are humans around 5 feet tall, but never 50 feet tall? (And why are blue whales "only" 100 feet long, but never 1000?) Why can a small amount of arterial buildup lead to a large amount of trouble? Why do elephants have such huge ears? Why are I-beams so widely used in construction projects? Why do dogs pant? What do the answers to these questions imply about building a society with meaningful interpersonal relationships? And last (but not least of all), how the heck do you get the last bit of toothpaste out of the tube? In this class, we will share a simple mathematical framework -- scaling and similitude -- that can be used to answer all these questions (at least partially... some are quite tough!). This framework helps enormously with high school homework, and it can single-handedly power you through a PhD. It is easy enough to grasp in an hour, yet so challenging that it takes a lifetime to master. Join this class and start the journey of a lifetime!



**Dr. Jerry Wang** is an Assistant Professor of Civil and Environmental Engineering, and Chemical Engineering (by courtesy) and Mechanical Engineering (by courtesy), at Carnegie Mellon University. He received his BS in 2013 from Yale University (Mechanical Engineering, Mathematics and Physics), SM in 2015 from MIT (Mechanical Engineering), and PhD in 2019 from MIT (Mechanical Engineering and Computation). He performed postdoctoral research at MIT in chemical Engineering. He was a member of the inaugural cohort of the Provost's Inclusive Teaching Fellowship at CMU, was the 2020 recipient of the Frederick A. Howes Scholar Award in Computational Science and the 2016 MIT Graduate Teaching Award in the School of Engineering and is an alumnus of the Department of Energy Computational Science Graduate Fellowship and the Tau Beta Pi Graduate Fellowship. Wang directs the Mechanics of Materials via Molecular and Multiscale Methods Laboratory (M5 Lab) at CMU.

### **TISSUE ENGINEERING AND BIOMATERIALS, Grades 6-8, September 23**

Medical devices vary from simple tongue depressors to complex implanted devices. We will discuss some medical devices such as pacemakers, simulators, pumps and implants. We will then follow with an introduction to biomaterials, the nonliving devices used to interact with biological systems. Hands-on activities including 3D printing will be used to solve some realistic medical situations.



**Dr. Rachelle Palchesko** is an Assistant Teaching Professor of biomedical Engineering. She received her B.S. in Biochem in 2006 Summa Cum Laude with a Provost's Scholarship from Indiana University of Pennsylvania. In 2011, she received her Doctorate of Philosophy from the Department of Chemistry and Biochemistry at Duquesne University. In 2011, Rachelle became a postdoctoral fellow at both the Department of Ophthalmology at the University of Pittsburgh and the department of Biomedical Engineering at Carnegie Mellon University (CMU), where she worked in the labs of Dr. James L Funderburgh and Dr. Adam Feinberg, respectively. From 2013 to 2016, Rachelle worked as a postdoctoral fellow solely in the lab of Dr. Adam Feinberg, until she was promoted to a Special Faculty member in the Department of Biomedical Engineering at CMU under the direction of Dr. Feinberg. Rachelle has taught courses at CMU focusing on Engineering Biomaterials, Polymeric Biomaterials, and Tissue Engineering.

# GELFAND OUTREACH

Fall Saturday 2023 Series Classes - Carnegie Mellon University

*Classes are \$55.00 each\* and are conducted from 9:00 AM to Noon on the Carnegie Mellon University campus.*

*\*To apply for scholarship funds, please submit a copy of the first page of your IRS 1040 tax form from 2022.*

## September 23<sup>rd</sup>

- Gr. K-2: Bug-Bots
- Gr. 2-4: Coding for Beginners
- Gr. 3-5: How Engineers Make Planes Fly
- Gr. 5-7: Math Turned Inside Out
- Gr. 6-8: Tissue Engineering & Biomaterials
- Gr. 7-9: Scaling and Similitude

## October 14<sup>th</sup>

- Gr. K-2: Building with Sticks and Straws
- Gr. 3-5: Marvelous Macromolecules
- Gr. 5-7: Complex Fluid Toys
- Gr. 7-9: Imaging and Single Photons
- Gr. 7-9: Digital Photography

## November 4<sup>th</sup>

- Gr. K-2: Art in Motion
- Gr. 3-5: Building Blocks of 3D Printing
- Gr. 3-5: Let's Get Building!
- Gr. 4-6: Robot Sensors
- Gr. 6-8: How 3D Displays Work
- Gr. 7-9: Brain-Bots

Students in Newell Simon Hall lab



Rigorous

Hands-on

Educational

Fun!