The daVinci Project 2022 (Workshops)

- **Understanding Pain: An Unpleasant Sensory and Emotional Experience in Your Brain**
  - **Faculty:** Dr. Bin Feng
  - **Description:** The current epidemic of prescription opioid abuse can be tracked back to more than a decade ago, when chronic pain became accepted as a disease of its own right and doctors started to prescribe opioids to patients for the humane need of managing pain. In this workshop, teachers will gain hands-on experience on pain as an unpleasant sensory and emotional experience in the brain. In particular, we will demonstrate that pain can be evoked in the absence of any tissue injurious stimuli using a thermal grill device as shown in the above figure. Teachers will learn how to build a low-cost thermal grill of their own, including fundamentals of CAD modeling in SolidWorks and 3-D printing. In addition, teachers will be introduced to the recent advances in various neuromodulation techniques as non-pharmacological alternatives for treating chronic pain.
  - **Fellowships Available:** two (2)
  - **Recommended For:** This workshop is recommended for Biology, Physics, General Science, and Technical Education teachers.
  - **Host Department Major:** Biomedical Engineering
- **Stream Health and Water Reuse in a Developed Watershed**

- **Faculty:** Dr. Tim Vadas
- **Description:** Learn about the intersection of engineered waste water treatment systems, hydrologic modeling, and stream health in developed landscapes and opportunities for water reuse. This workshop will provide you with a mixture of activities to take into your classroom. We will wade a stream to assess biological water quality indicators, understand water quality measurements and toxicity, examine water treatment processes for both treatment and generation of contaminants, and consider treated wastewater in reuse applications to grow crops. This will give you tools to run units in water quality, water treatment, or water reuse using a stream or wastewater treatment plant near your own school.
- **Fellowships Available:** two (2)
- **Recommended For:** This workshop is highly recommended for Chemistry, Biology, and General Science teachers.
- **Host Department Major:** Civil and Environmental Engineering

- Bioinformatics: Using Computer Science to Understand Life

- **Faculty:** Dr. Mukul Bansal
- **Description:** Over the past few decades there has been tremendous progress in the ability to sequence genomic information and gather vast quantities of data related to the molecular processes within cells. As a result, biology has now become an information science, with computational, mathematical, and statistical techniques all playing a critical role in discovering new biology, improving medicine, and understanding how life evolves and works. In this course, we will discuss the application of computational algorithms to

important problems in biology and medicine. The first half of the course will provide a broad overview of bioinformatics and discuss some exciting, cutting-edge topics in bioinformatics. In the second half, participants will learn how genomic sequence information can be used to reconstruct the evolutionary histories of the millions of species on Earth. Participants will learn how to download and assemble their own sequence datasets and will learn how to apply computational algorithms to reconstruct the evolutionary relationships between their species of interest. This hands-on activity can be easily replicated in high-school classrooms.

- **Fellowships Available:** Three (3)
- **Recommended For:** This workshop is highly recommended for Biology and Math teachers.
- **Host Department Major:** Computer Science and Engineering

- Environmental [In]justice Workshop

- **Faculty:** Dr. Randi Mendes
- Description: Join us for a workshop looking at environmental justice and injustices that occur in the past and continue to occur in society. Learn more about how different practices we view as "normal" are in fact racist or oppressive to different communities, and what we can do about them. Also, learn how engineers take part in environmental justice and society. This workshop will be able to accommodate up to 10 teachers.
- **Fellowships Available:** two (2)
- **Recommended For:** This workshop is highly recommended for Environmental Science, Biology, Chemistry, and General Science teachers. ** Schools could also bring Social Studies

or History Teachers, and even collaborate with their peers on interdisciplinary or crosscutting lessons.

- **Host Department Major:** Vergnano Institute for Inclusion / Civil and Environmental Engineering

- **Innovative Underwater Robotics for STEM Projects**
  - **Faculty:** Dr. Shalabh Gupta
  - **Description:** This project will engage high school teachers in an effort to develop a skill set in simulating, constructing, and testing autonomous underwater vehicles (AUVs). At the first step, the participants will learn about the operation of AUVs as well as obtain good understanding about their sensing capabilities via working on a high-fidelity 3D underwater simulator, where they will simulate and run various realistic AUVs. At the second step, they will build simple underwater vehicles and subsequently test them. Teachers participating in this workshop will receive a SeaPerch kit to design and build during this workshop and an unassembled SeaPerch kit to take back to their classrooms. The participants will also get to see and examine laboratory scale AUVs and learn about the real-life challenges of underwater navigation. Through this fun project, teachers can present the following concepts in their classrooms:
    - Submarine and AUV design
    - Buoyancy/displacement
    - Propulsion
    - Side scan sonars
    - Waterproofing
    - Depth measurement
    - Attenuation of light

    - Basic physics of motion
- **Fellowships Available:** This workshop will be able to support 8 teachers (up to $600 per participant will be covered by Navy STEM grant funds).
- **Recommended For:** This workshop is highly recommended for Physics, Computer Science, Math, and General Science teachers.
- **Host Department Major:** Electrical and Computer Engineering

- Smart Films and Flexible Electronics

- **Faculty:** Dr. Kyungjin Kim
- **Description:** Imagine our smartphones, smartwatches, cardiac pacemakers, and batteries are made in the form of lightweight thin films and further attachable on your skins like tattoos! Wearable and implantable electronics are developing fast as next-generation form factors and highly interdisciplinary research areas comprised of electrical and mechanical engineering, micro-nano and materials science, and chemical and biomedical engineering. The workshop will start with the introduction of various thin-film applications with eye-catching video materials, followed by electronics basics, device structures, materials that are essential ingredients to design mechanically and electrically reliable thin-film devices. Teachers participating in this workshop will have the opportunity to design and integrate simple exemplary thin-film electronic circuits, encapsulate them, and operate devices under various mechanical deformations and environments underwater. Through this workshop, teachers can offer multiple fun projects for the students!
- **Fellowships Available:** One (1)

- **Recommended For:** This workshop is highly recommended for Math, Physics, and General Science teachers.
- **Host Department Major:** Mechanical Engineering