2017 TJ High School Science and Engineering Summer Institute

Computer Controlled Prototyping

This course focuses on the fundamentals of programming and operating computer controlled (CNC) machinery. Students will learn how to prepare material for both a CNC lathe and CNC mill, properly locate the material, and execute programs to create custom components. Students will also learn how to use computer aided design software to create custom designs and then program the machines to create those parts. Once machined, students will assemble their parts to create a working prototyping.

Length of course:	**One week**
Dates Offered:	**July 10-14** **July 17-21**
Suggested Prerequisite:	**Technology Education Classes**
Lab Fee:	**$0.00**

Explorations in Marine and Environmental Science

This course is a non-credit introduction to research, careers, and issues in the marine and environmental sciences. In this course students will have a wealth of experiences from the mountains to the sea. This class is designed to help students prepare to conduct quality research, and also to provide a unique set of experiences for students interested in pursuing a career in these fields.

Field experiences vary from visiting a fish hatchery, sampling, and fishing in the Shenandoah Valley, to studying, collecting, and boating in the Occaquon River, and further to working at a commercial shellfish farm, participating in a research trawl survey, and collecting shells along the Atlantic Ocean. Students will also travel to local museums for behind-the-scenes programs.

There are lab fees associated with this course to offset the field experiences- $400.00

Length of course:	**Three week**
Dates Offered:	**July 10-28**
Suggested Prerequisite:	**N/A**
Lab Fee:	**$400.00**

Introduction to Android App Development

The course will introduce students to the world of developing apps for Android smartphones using the Android Studio development environment. Participants will learn how to install the necessary software and related packages, the anatomy of an Android app, how to handle user input, work with multiple screens, store data, and access real-world data using APIs.

While the course will teach participants the basics of Android development, this is not a course that will teach programming. Participants will need a strong knowledge of Java, in particular they need to have a good command of object-oriented development. Therefore, participants must have completed **AP Computer Science A or IB Computer Science** in order to enroll in the course. Students are encouraged to bring their own laptops and Android phones to use, but neither are required for the course. Computers and mobile devices will be available for use throughout the week.

Length of course:	**One week**
Dates Offered:	**July 10-14** **July 17-21**
Required Prerequisite:	**AP Computer Science A or IB Computer Science**
Lab Fee:	**$0.00**

Instrumental Methods of Chemical Analysis

Integrating and building upon prior knowledge from Chemistry I and AP Chemistry, students will explore chemistry through advanced laboratory projects that utilize upper-level HS Chemistry Instrumentation. This course is offered to students who wish to explore areas of advanced chemical analysis and environmental analysis research. The focus of course will include project areas related to inorganic synthesis methods and analytical methods including chemical and spectroscopy. Throughout the week students will be compiling their knowledge, experiences, and results in a comprehensive report to showcase what they have learned. The nature of such a course requires students to already be proficient in Chemistry having already completed AP Chemistry, and also requires that students be prepared to work responsibly and collaboratively at advanced laboratory offerings. The skills gained would help students to better understand how to develop projects for competitions such as the Science Fair or other National level programs.

Length of course:	**One week**
Dates Offered:	**July 24-28**
Required Prerequisite:	**AP Chemistry**
Lab Fee:	**$100.00**

Conventional and Alternative Energies

Students will spend one week learning about conventional and alternative energy through research and hands on projects. Students will walk through the fundamentals of mechanical, hydraulic and pneumatic systems. They will then learn about conventional energy systems such internal combustion, steam power, and electric. The course will then dive into the current alternative sources such as solar and wind; and then take a look at upcoming advances in energy and transportation like Hyperloop technology. The class is very hands on and will include an introduction to research and engineering.

Length of course:	**One week**
Dates Offered:	**July 10-14** **July 17-21**
Suggested Prerequisite:	**Technology Education Classes**
Lab Fee:	**$0.00**

Custom Interfacing with Arduino

Students enrolled in this course will be learning the ins and outs of creating custom physical interfaces for computer programs. Electronic circuitry combined with the programmable Arduino microcontroller will be used to create a link between sensors and the computer all packaged in 3D printed and laser cut enclosures. Possible applications include custom keyboards, game controllers, brain-computer interfaces, MIDI controllers and much more.

Length of course:	**One week**
Dates Offered:	**July 10-14** **July 24-28**
Suggested Prerequisite:	**Technology Education Classes**
Lab Fee:	**$0.00**

The Rise of SuperBugs: A Crash Course in Microbiology and Scientific Communication

In this hands-on lab course we'll dig into gene expression and evolution of microbial resistance while practicing introductory microscopy and microbiology techniques including transformation, sampling and culture of bacteria, and staining and visualizing samples. We'll also discuss current events and discoveries related to antibiotic resistance while working on designing infographics to inform the public about the nature of science, evolution, and antibiotic resistance.

Length of course:	**One week**
Dates Offered:	**July 24-28**
Suggested Prerequisite:	**Honors Biology or AP Biology**
Lab Fee:	**$0.00**

Science Writing & Communication

Becoming a better writer requires practice, feedback, and revision opportunities. We will work through the stages of science writing that will be based on topics of individual student interest. The skills we'll cover and the opportunities the students will have to practice writing will include: strategies for reading scientific articles efficiently, annotating primary sources, synthesizing information, writing an abstract and literature review in APA style, and presenting research in a professional manner. This course will be useful for anyone interested in reading and writing about science – whether for use in science fair projects, IB extended essays, senior research or capstone projects, science competitions like Siemens or the DuPont Challenge, or general interest. (No previous experience with science writing is necessary; students will be able to work starting at whichever level they're comfortable.)

Length of course:	**One week**
Dates Offered:	**July 17-21**
Suggested Prerequisite:	**N/A**
Lab Fee:	**$0.00**

Measuring the electrical properties of sensory and nervous system cells in organisms

Explore the basics of Neuroscience and develop the groundwork for future Science Fair, Siemens, Regeneron or other research competitions. Using relatively inexpensive electronic recording devices, students will learn how to conduct electrophysiology experiments to explore the sensory nervous system of organisms such as fruit flies (Drosophila melanogaster) and Venus flytrap plants.

Length of course:	**One week**
Dates Offered:	**July 10-14**
Suggested Prerequisite:	**AP Biology**
Lab Fee:	**$0.00**

Brain Machine Interface: Using Machine Learning to analyze and use Human Brain Signals

Explore the basics of Brain-Computer Interface (BCI) and develop the groundwork for future Science Fair, Siemens, Regeneron or other research competitions. Using Electroencephalograms (EEG) and some introductory signal processing and machine learning algorithms, participants will learn how to analyze the complex electrical signals in the human brain to understand human perception or control electrical devices.

Length of course:	**One week**
Dates Offered:	**July 10-14** **July 17-21**
Suggested Prerequisite:	**AP Biology**
Lab Fee:	**$0.00**