

# OKLAHOMA SCHOOL of SCIENCE and MATHEMATICS

## OSSM Summer Academy 2023 Course Descriptions

### A Concise History of Science

Monique Baxter

Session 1 (July 17-21) or Session 2 (July 24-28)

This course examines the roots of science from antiquity through the Scientific Revolution of the 17th century. Emphasis is placed on the development of major philosophies/theories, scientific advancements, and the individuals credited with establishing the historical foundations of science.

### A Gentle Introduction to Complex Numbers

Caleb Cook

Session 1 (July 17-21) or Session 2 (July 24-28)

This course will offer students a gentle introduction to the beautiful world of complex numbers. We will spend time learning how to solve various algebra/trigonometry problems with complex number computations, before moving on to the geometric aspects of the complex number plane. At the end of the week, we will wrap up with computer visualizations of complex functions, made with the Mathematica computer algebra system. Prerequisites: Though previous exposure to trigonometry may be helpful, students who have successfully completed Algebra I will be prepared for this course.

### A Gentle Introduction to Quantum Mechanics

Caleb Cook

Session 1 (July 17-21) or Session 2 (July 24-28)

This course will give students a gentle, conceptual introduction to quantum theory. We will begin with the basics of wave-particle duality, the Schrödinger equation, the Heisenberg uncertainty principle, quantum states, and measurements, taught to students via a combination of lecture, group discussion, and in-class activities. At the end of the week, we will move onto real-world applications of quantum mechanics, including quantum computing and quantum cryptography. Prerequisites: Students who have taken Algebra I will be able to follow the course, but additional math courses beyond Algebra I would be helpful.

## An Introduction to the Human Body in Health and Disease

Mark Li

Session 1 (July 17-21) or Session 2 (July 24-28)

This course provides an introduction to human biology and the science of medicine. Students explore the intricate anatomical and physiological mechanisms underlying normal human function in different organ systems and homeostatic imbalances that cause diseases. For example, in learning about diabetes, students gain an understanding of the endocrine system. Lab work includes nerve reflexes, sensory illusions, heart auscultation, blood typing, blood pressure and EKG measurements, and structure and function of eyes (including dissections of mammalian animal eyes).

## Animal Anatomy and Adaptations

Brent Richards

Session 1 (July 17-21) or Session 2 (July 24-28)

Some are hairy, some are scaly, and some are slimy. Some have legs, some have wings, and some have fins or tentacles. Some are as big as a building, and some are too small to see without a microscope. Animals have conquered every possible habitat on earth, and they make up a crucial part of the planet's ecosystem. But how did they get to be the way they are? How can they be so different from each other and yet share a common ancestor? We will get up-close and personal with a few representatives of the animal kingdom and study them both inside and out.

## Calculus - A Gentle and Intuitive Introduction

Frank Wang

Session 1 (July 17-21) Only

Dr. Wang takes a fun and lighthearted approach to the teaching of the "big concepts" of calculus. Each day of the week he wears a different hat and delivers an interactive lecture on a facet of calculus.

## Competitive Research

Sharon Jorski

Session 1 (July 17-21) or Session 2 (July 24-28)

Competitive research will give you the edge as you prepare for Science Fair projects, National History Day projects, essay/scholarship competitions and the traditional research paper. This class will teach skills and strategies for finding, evaluating, and using information. The class will use both traditional and online tools as well as print and digital sources. A variety of research and information management skills will be covered including selecting a topic and creating a research strategy. An actual research paper will not be written.

## Creative Problem Solving

Sharon Jorski

Session 1 (July 17-21) or Session 2 (July 24-28)

Creative problem solving and critical thinking skills will be used individually and in groups to solve a variety of creative challenges including problems, puzzles, games, and riddles. Problems will be solved using non-math skills such as diagramming, brainstorming, information gathering, observation, and data analysis to encourage not only lateral and linear thinking but also left and right brain thinking. Students will develop their creative skills by expressing their ideas and their critical thinking skills by reasoning through logic, as well as skills that overlap the two categories.

## CSI Past & Present

Monique Baxter

Session 1 (July 17-21) or Session 2 (July 24-28)

Students in this course will examine several criminal cases throughout history, learn about the crime scene methodology used at the time, and the modern technology being applied to these cases today.

## Engineering Projects: Design and Build

Ron Mashore

Session 1 (July 17-21) or Session 2 (July 24-28)

This introduction to ENGINEERING will provide the students with useful information to assist them in their EDUCATION and CAREER DECISIONS. This course will examine, study, and discuss the wide variety of engineering fields as well as what Engineers do. Discuss job classifications and duties: e.g. Electricians, Mechanics, Technicians, Designers, Researchers, Engineers, Licensed Engineers. We will also discuss Career Options: Credentials, Choices, Success Factors, Self-fulfillment.

## Hands-on Digital Electronics using Arduino

Bill Underwood

Session 1 (July 17-21) or Session 2 (July 24-28)

Students will learn the difference between a computer and a controller (Arduino UNO). They will construct several electronic circuits and program their functions, collect data and control hardware. This will include LEDs, measuring temperature and humidity, using a datapad and a RFID reader. Students will be given a USB flash drive with sample code which they can modify as desired.

## Hands-on Physics

Bill Underwood

Session 1 (July 17-21) or Session 2 (July 24-28)

In a letter dated 5 February 1676, Sir Isaac Newton said, "If I have seen further it is by standing upon the shoulders of Giants." The giants he was referring to included Archimedes, Pythagoras, Descartes,

Kepler, Galileo, and many others. In this course students will use hands-on physics experiments (laboratory exercises) with class discussion and limited instructor presentations, to gain an understanding of Newtonian (classical) physics and the important ideas that pointed the way.

## Innovative Robotics Engineering and Programming

Sharon Jorski and Bill Underwood

Session 1 (July 17-21) or Session 2 (July 24-28)

Students will build and program autonomous robots in teams of 2-3 throughout the duration of the class while continuously engineering their robots to improve them for new challenges such as obstacle courses. Students will learn about the engineering process and basic coding skills along the way.

## Intro to micro/nano electronics with hands on Arduino

Manisha Chakraborty

Session 1 (July 17-21) Only

Introductory electronics, band structure, semiconductor technology with hands on Arduino sketches programming.

## Intro to Trigonometry for ACT/SAT/PSAT

Sara Marie Bodenstein

Session 2 (July 24-28) Only

An introduction to the basics of trigonometry useful for the ACT, SAT, or PSAT. This course will be most effective if you have had Algebra I and Geometry, but it is not required. Bring a Wi-Fi enabled laptop for daily Kahoot competitions.

## The World of Engineering: Fields And Careers

Ron Mashore

Session 1 (July 17-21) or Session 2 (July 24-28)

Concentrate on synergy through teamwork and group problem-solving of practical engineering-type problems. Participate in hands-on lab projects based upon practical applications of science, physics, assumptions, and judgment e.g. electromagnets, catapults, friction, and popsicle bridge. Develop teamwork and competitive skills with problem identification and solving.