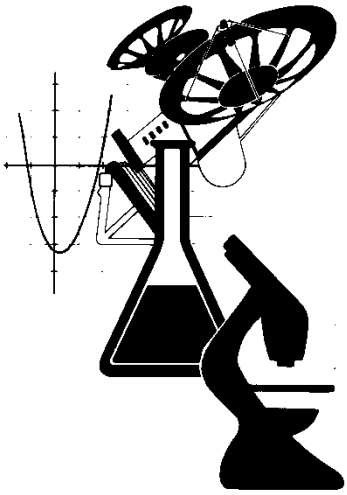

Governor's School
of
New Jersey Program
in the
Sciences
at
Drew University

2026

COURSE CATALOG

2026 GSNJS COURSE CATALOG

CONTENTS

PROGRAM DESCRIPTION

The Governor's School in the Sciences has several objectives. The first is to broaden the scholars' appreciation and knowledge of science through exposure to a range of scientific topics and scientists. The subject of career exploration and choice is woven throughout the program. The second objective is to introduce scientific research to the scholars via hands-on research experience in a student's area of interest. Resources from New Jersey's industrial, governmental, and academic science establishments are used.

The program at Drew consists of a number of components designed to accomplish the objectives.

1. There is a core curriculum of six courses in biochemistry, physics, chemistry, mathematics and biological anthropology. Offered four times a week, these courses address aspects of these fields not normally seen in either high school or first year college. *Students are required to select **three** courses from this core.* Homework is assigned, although no grades are given for the courses.

2. Biology, organic chemistry, computer science, physics and molecular biology laboratories are held two afternoons a week. Each offers innovative experiments. *Each student must select **one** lab course.*

3. Three afternoons a week are set aside for work on team projects. Students work in small teams under faculty guidance on mini-research topics. Recent topics have included olfactory learning and memory, modeling small molecule movement across a polymer membrane, machine learning in python, impact of air pollution on biogeochemical cycle, cloning and functional complementation of EF3. The final day of the school is devoted to a scientific meeting at which teams report their results to the entire group. Work on the research projects frequently takes place during free times on weekends.

4. Evening colloquium speakers discuss modern science from both industrial and academic viewpoints. This allows a glimpse into doing science and provides a discussion of real-world considerations related to work in science.

During free evenings and weekends, there is time for study, as well as for recreation, on the campus and in the town of Madison. Entertainment and special events on campus include films, Career Day and a Talent Show. Students can attend local religious services nearby.

Closing ceremonies are held at a farewell gathering for all scholars, faculty, counselors, and visiting dignitaries.

The faculty for the Governor's School in the Sciences includes science faculty from Drew and other local colleges and high schools.

Free of exams, grades, or any form of AP or college credit, the experience of scholars spending an intensive period of time working, learning, and living together always has proved to be productive, satisfying and memorable for all concerned.

2026 GOVERNOR'S SCHOOL IN THE SCIENCES COURSE SCHEDULE

CORE COURSES (M, T, Th, F)			
9:00 am – 10:00 am			
HS-4	C1	Neurobiology	Knowles/ Brenna
HS-308	C15	Cybersecurity	Michlin/
10:10 am – 11:10 am			
HS-308	C4	Molecular Orbital theory	Pearsall/
HS-4	C8	Human Evolution	Windfelder/
11:20 am – 12:20 pm			
HS-4	C11	Molecular Biology of Cancer	Dunaway/
HS-308	C3	Special Relativity: Concepts, Consequences, and Applications	Gonzalez Silva/
LABORATORIES (T, Th*) 1:30 pm – 4:15 pm (July 14, 16, 21, 23, 28, ***29)			
HS-226	L2	Experiments in Organic Chemistry	Pearsall/
HS-229	L5	Experiments in Biochemistry	Cassano/
HS-203	L6	Experiments in Physics	Murawski/
HS-133	L14	Experiments in Field Ecology	McQuigg/
TEAM PROJECTS (M, W*, F) 1:30 pm – 4:15 pm (July 13, 15, 17, 20, 22, 24, 27, ***30)			
HS-3A	T6	Project in Archaeology and Material Science	Masucci/
HS-106	T12	Project in Psychology: Cognitive Illusions	Dolan/
HS-139	T22	Project in Computer Science: AI-assisted Discovery of Physics Laws	Kouh/
HS-208	T23	Project in Molecular Biology	Barker/
HS-133	T24	Project in GIS	Yan/

Team Projects and Laboratories are switched in the last week with Labs meeting on Wed (July 29) and Projects meeting on Thurs (July 30)

CORE COURSES

C1 NEUROBIOLOGY

INSTRUCTOR: Roger Knowles, Drew University

In this course, students explore the biological basis for the mental processes by which we think, perceive, learn and remember. First, students study how neurons in the brain communicate with each other, with an emphasis placed on molecular mechanisms of synaptic transmission. Next, students examine how sets of neurons are organized into functional anatomical regions and how signaling among these regions give rise to discrete cognitive systems. Using tools gained from these cellular and anatomical lessons, students then debate two major questions in neurobiology: 1) how does the brain store memories, and 2) what happens to the brain when Alzheimer's disease robs patients of their memories. Throughout this course, students are challenged to consider how ongoing and future research can further our understanding of how the brain functions.

C3 SPECIAL RELATIVITY: CONCEPT, CONSEQUENCES, AND APPLICATIONS

INSTRUCTOR: David Gonzalez Silva, Colts Neck High School / Rutgers University

This course explores Einstein's Theory of Special Relativity, a groundbreaking framework that reshaped our understanding of space, time, and motion. Beginning with Einstein's two postulates, the course builds toward a conceptual and mathematical understanding of relativistic kinematics and the surprising implications of the theory, including simultaneity, and the relativistic effects of time dilation, and length contraction. To help students visualize and analyze these phenomena, the course introduces spacetime diagrams and light cones, along with transformations between different reference frames, inertial and noninertial. Students will also examine relativistic momentum and energy, as well as the Doppler effect for electromagnetic waves. The course will also touch on foundational ideas from General Relativity with an emphasis placed on developing a strong conceptual grasp and connecting theoretical insights to real-world applications such as the Global Positioning Systems, satellite communications, and stellar spectroscopy. The course is accessible to students with minimal previous backgrounds in physics and aims to challenge common conceptions shaped by experiences at everyday speeds, offering an exciting window into the counterintuitive yet experimentally confirmed nature of relativistic phenomena.

C4 AN INTRODUCTION TO MOLECULAR ORBITAL THEORY

INSTRUCTOR: Mary-Ann Pearsall, Drew University

Chemistry is centered around the study of atoms and their interactions with each other to form chemical bonds. You may have noticed that many of the principles of chemistry require you to accept "exceptions" and things that do not quite fit. In this course, we will examine a more sophisticated electron-wave based approach to chemical bonding which is known as molecular orbital theory. We will use this approach to describe the bonding in a variety of systems to obtain some clarity of understanding into the sometimes rather contradictory guiding principles of conventional bonding theories

We will begin with a description of electron waves in atoms, and then review the conventional bonding theories of ionic and covalent bonds. As we do, we will highlight some of the problems with these approaches, and acknowledge places where our conventional theories are no longer sufficient, even for simple molecules such as oxygen and hydrogen sulfide. We will then apply our understanding of electron waves in atoms to chemical bonding to develop a cohesive and elegant understanding of

bonding. Then, with stunning simplicity, we will resolve the puzzles posed by those annoying exceptions, and unsatisfying descriptions such as resonance and metallic bonding. In doing so, we will gain insight into the beauty of molecules and the amazing ways that atoms can put themselves together. A solid background in chemistry will be assumed. One year in high school will be fine. This material does not repeat AP chemistry and is appropriate whether or not you have completed an AP chemistry course.

C8 HUMAN EVOLUTION

INSTRUCTOR: Tammy Windfelder, Drew University

This course approaches human evolution from a theoretical point of view, combining both biological and cultural processes into a cohesive bio-cultural model. It begins by tracing the development of modern evolutionary theory and then turns to the many lines of evidence used to explore and explain human evolution. These lines of evidence include studies of our primate relatives, discoveries from the fossil record, patterns of modern day genetic variation, and archaeological evidence. Modern human variation can only be explained as the end result of evolutionary forces acting on the complex interplay of biology and culture over millions of years. We continue to be affected by these forces, and this course not only provides information about where we came from, it also provides the scientific background to help us understand where we might be going as our species continues to evolve.

C11 MOLECULAR BIOLOGY OF CANCER

INSTRUCTOR: Stephen Dunaway, Drew University

As a disease of the DNA, cancer can arise from disruption of multiple cellular pathways, particularly those that control cell cycle progression. The course will focus on the initial observations of the molecular basis for this group of diseases at the outset. Then we will expand our coverage of the topic by focusing on various oncogenes and tumor suppressor genes that play prominent roles in cancer development. We will spend time investigating how cells monitor and protect genomic stability and the roles these pathways play in preventing cancer. We will also investigate how cancer cells progress to a metastatic state which allows them to freely circulate throughout the body. Finally, we will spend time discussing various clinically relevant cancer treatments.

C15 CYBERSECURITY

INSTRUCTOR: Adam Michlin, Drew University

Introduction to Cybersecurity

Introduces common issues of Cybersecurity. Aims to help students understand the enduring crisis of cyber security from both technical and social perspectives. Topics may include technical and social constructions of cyberspace, malicious content, social media related risk, secure online activity, protection of privacy, as well as cultural and ethical dimensions of Cybersecurity.

LABORATORY

L2 EXPERIMENTS IN ORGANIC CHEMISTRY

INSTRUCTOR: Marry-Ann Pearsall, Drew University

Organic chemistry is the chemistry of carbon-containing compounds. In this laboratory you will learn some of the experimental techniques used in organic chemistry and explore how structure affects properties and reactivity. In the experiments that you will do, you will extract some organic molecules from natural sources, and synthesize (make) others. You will characterize these molecules using a variety of methods. This laboratory requires a background of high school chemistry.

L5 EXPERIMENTS IN BIOCHEMISTRY

INSTRUCTOR: Adam Cassano, Drew University

PROTEIN PURIFICATION AND ENZYME ACTIVITY OF YEAST ALCOHOL DEHYDROGENASE

"Never waste pure thoughts on an impure protein." Proteins are large biomolecules made of smaller building blocks called amino acids that are organized into chains to form intricate three-dimensional structures. In the laboratory, proteins are purified from complex mixtures, such as cells or tissues, through a series of processes that are selected based on the properties of the protein of interest. Only once the protein is isolated can the the function, structure, and interactions can be characterized and studied. In this hands-on laboratory course, participants will isolate the protein, Alcohol Dehydrogenase (ADH), from yeast. Yeast alcohol dehydrogenase (YADH) is a special type of protein, called an enzyme, responsible for catalyzing the conversion of an aldehyde to ethanol (alcohol) during the fermentation of glucose. Classical protein purification techniques will be employed, including cell disruption, protein precipitation, affinity chromatography, dialysis, and centrifugation. Once protein purity has been established using gel electrophoresis, and protein concentration has been calculated using a Bradford colorimetric assay, participants will measure the enzymatic activity and specificity of the isolated YADH protein using absorption spectroscopy.

L6 EXPERIMENTS IN PHYSICS

INSTRUCTOR: Robert Murawski, Drew University

ELECTRONICS LABORATORY

Electronic devices are pervasive in every aspect of today's world. From emails to EVs, from solar panels to cell phones, and from batteries to Bitcoins, almost all modern conveniences are thanks to electronics. Therefore, a solid understanding of electronics is a key to understanding the way the modern world operates. In this series of labs, we will take a look at what is under the hood of electronic devices. The fundamentals of DC and AC circuits will be taught and the labs will coincide with the lectures. Starting from the basics of Ohm's law and working towards small signal amplification, the focus of the labs will always be a learn by doing approach. Students will leave with a deeper appreciation of electronics and hopefully start to see the invisible world behind the plug.

L14 EXPERIMENTS IN FIELD ECOLOGY

INSTRUCTOR: Jessica McQuigg, Drew University

Field ecology is a hand-on field-based lab which will teach students field and laboratory techniques alongside statistical testing and data interpretation. In this lab we will investigate how White-tailed Deer affect leaf litter invertebrate communities, compare multiple invertebrate sampling techniques, use microscopes to identify some of the smallest terrestrial animals alive, and explore vegetation communities across multiple habitat types. Most laboratory sessions will take place outdoors and requires shoes and clothes that can be easily washed.

TEAM PROJECTS

T6 PROJECT IN ARCHAEOLOGY

INSTRUCTOR: Maria Masucci, Drew University

ARCHAEOLOGY AND MATERIALS SCIENCE: THE RED ETCHED STONES FROM ANCIENT CAESAREA: COPIES OR TRADE?

Beads and ornamental objects made from a bright red and orange type of quartz stone known as "Carnelian" have been created and highly prized by ancient cultures from the Indus Valley of India and Pakistan to Mesopotamia and Egypt, continuing on through Roman, Byzantine and the Medieval periods. Most archaeologists believe that these objects were made by specialists in Southwest Asia and traded across vast networks in the ancient world. It is also possible that some may have been made by craft specialists moving to centers of civilizations or as local "knock offs" or copies. The most prized of these objects carried etched designs created through a process which has never fully been discovered. A small set of etched and unetched Carnelian beads were discovered in burials at the ancient Roman and Crusader port city of Caesarea Maritima on the Mediterranean Sea. These objects may be attempts at locally made copies or possibly obtained as trade items. Understanding the movement of materials and precious items offers clues to ancient contact and trade as well as religious beliefs and craft manufacturing processes. Archaeology now has a range of analytical tools from Materials Science which can help investigate these questions. Further, Archaeologists can employ experimental approaches to investigate hypotheses of how designs are created. Are the red and orange etched beads from Caesarea actually Carnelian? Are they local materials and all made from the same material? Or, were they more likely imported items? How were the etched designs created? To investigate these questions and contribute to our understanding of ancient trade, interactions and crafts our Team Project will employ multiple types of analysis including experimental archaeology to test hypotheses of design creation, macroscopic analysis using 3D scanning and photogrammetry to compare the manufacturing traces on the different beads, and geochemical analysis of stone samples and artifacts from Caesarea. With these multiple lines of data our goal is to contribute to the understanding of ancient lines of contact and help uncover a long unknown craft design process.

T12 PROJECT IN PSYCHOLOGY

INSTRUCTOR: Patrick Dolan, Drew University

COGNITIVE ILLUSIONS

Illusions fascinate us because they trick us into believing something that is quite different from reality (*illudere* - to mock). Far from just a curiosity, illusions provide a window into our thought processes and

how the brain works when it is not being tricked. Equipped with the ability to process only a limited amount of information, the brain develops “shortcuts” in order to handle the enormous amount of information received from our five senses. While these shortcuts often serve us well, they occasionally fail us, leading to cognitive illusions. This team project will research some facet of cognitive illusions related to our perception, memory, or reasoning.

T22 PROJECT IN COMPUTER SCIENCE
INSTRUCTOR: Minjoon Kouh, Schmidt Sciences

TESTING AI FOR SCIENTIFIC DISCOVERY
Course Description: Modern AI technologies, such as Large Language Models (LLMs), are rapidly advancing, and with their increasing capacities for complex tasks, they are starting to play an important role in the scientific discovery process. In this Team Project, we will explore what LLMs can do (and they cannot do), by designing simple benchmarks and evaluating several LLMs. These benchmarks are intended to reveal whether and how effectively LLMs can provide discovery-like reasoning, rather than to extract specific scientific facts or produce novel research outcomes. We will also reflect on the limitations of our approach and the future role of AI in scientific research.

T23 PROJECT IN MOLECULAR BIOLOGY
INSTRUCTOR: Brianne Barker, Drew University

HOST-PATHOGEN INTERACTIONS: REGULATING IMMUNE SENSING TO PREVENT DISEASE

In this Team Project, we will study the signaling that occurs in an infected cell to allow that cell to induce an immune response. The immune system employs multiple layers defenses in order to prevent disease following infection. At the same time, immune responses must be tightly regulated in order to prevent causing tissue damage and disease themselves. Here, we will explore the immunity that occurs in an infected cell immediately after infection. Recent studies have suggested that host cells detect viral nucleic acid and initiate a complex signal transduction pathway to transcribe new products to change their biology or send signals to other cells. Here, we will explore the regulation of this signal transduction pathway following nucleic acid sensing to understand how it can be limited to avoid immunopathology. In this project, you will learn skills involving aseptic technique, tissue culture of mammalian cells, gene cloning, quantitative PCR, and immune activation assays.

T24 PROJECT IN GEOGRAPHIC INFORMATION SYSTEM
INSTRUCTOR: Han Yan, Drew University

Maps shape how we understand the world, but they are more than just representations of space. Geographic Information Systems (GIS) allow us to analyze complex relationships between environmental, social, and built systems, revealing patterns that are not immediately visible. By integrating spatial data with real world observations, GIS provides a pathway for addressing challenges related to sustainability, public health, and community planning.In this Team Project, we will explore how GIS can be used to investigate real-world geo-spatial inquiries. Students will learn how to collect, manage, and analyze spatial data,and examine how spatial thinking supports decision making and communication.

2026 SCHEDULE - NEW JERSEY GOVERNOR'S SCHOOL IN THE SCIENCES

	SUN	MON	TUE	WED	THUR	FRI	SAT
7:45 am – 8:45 am	Breakfast						
9:00 am		Core Course C1 C15		Free Time	Core Course C1 C15		**Career Day** 7/12 10:00 am – 12:15 pm
10:10 am		C4 C8			C4 C8		
11:20 am		C3 C11			C3 C11		
12:30 pm – 1:15 pm	Lunch						
1:30 pm – 4:15 pm Team/Lab		Team Project	Laboratory	Team Project	Laboratory	Team Project	
5:00 pm	Dinner						
7:00 pm			**Speaker** **7/14** Bouwman **7/21** Racciniello **7/28** Kouh				
Evenings	**Events** 7/26 Talent Show				Rehearsal 7/30	**Events** 7/31 Conferences **Dance** 7/17 7/31	