Gilman’s science requirement is two full year courses of lab science although many boys take three, four, and sometimes more science courses. The normal sequence of courses is Physics or Physics (Honors) in ninth grade, Chemistry or Chemistry (Honors) in tenth grade, Biology or Biology (honors) in junior year, and electives in the senior year.

Departmental approval (Mr. Morrison) is required for enrollment in an Honors or Advanced Placement course. Many of the elective science courses have prerequisites; please review them carefully.

9th Grade Lab Courses

**PHYSICS NINE**
This lab course is an introduction to the physical world. All incoming 9th grade students will be exposed to a year’s worth of Physics. The first semester is broken down into units covering kinematics in one dimension, Newton’s Laws of Motion, Equilibrium, Conservation Laws, Circular Motion, Machines, and Work and Energy. The second semester will encompass discussions involving Electricity, Magnetism, Waves and Sound, Light and Color, and Matter and Energy. With each unit, the students will be expected to use logical thinking, algebra skills, and work independently as well as collaboratively in both lecture and lab settings.

**PHYSICS NINE (Honors)**
This course is offered to those students, by placement from their 8th grade science and math instructors, who have a deep interest in the sciences. This course covers many of the same topics as in the Physics 9 course, but in greater depth. Students enrolled in this course must be dedicated, insightful, and capable of apply more intricate math skills in their problem solving.

9th Grade Course -- Elective

**ROBOTICS**
This class is designed for ninth grade students especially interested in robotics, computer science, mechanics and engineering. During the first semester, students will design and build a robot, learn to program it in java, operate it and train with it in order to participate in the FTC challenge. This is a competition that attracts thousands of high school and middle school teams from around the world. Students will collaborate to understand the problem presented to them, come up with the best design and build a robot out of commercially available parts and raw materials. Students will also sharpen their oral and written expression to communicate their findings. Competitions take place over two Saturdays in January and February and students are required to attend. During the second semester, students will participate in smaller groups in other local robotics competitions with different platforms that put more emphasis on electronics. Note: the first semester may include 9th, 11th, and 12th grade students. Since the FTC challenge is different every year, upper classmen may return and participate in the competition again under the course named Robotics II or Robotics III.

10th Grade Lab Courses

**CHEMISTRY**
This laboratory course is designed to introduce students to the fundamental concepts of chemistry. These include atomic theory, atomic structure, periodicity of the elements, molecular structure and behavior, stoichiometric interpretation of chemical reactions, gas behavior, reaction rates, thermodynamics, solution chemistry, and acid-base equilibrium. The course emphasis is on abstract and logical thinking.

**CHEMISTRY (Honors)**
This advanced level lab course is offered to sophomores who have successfully completed Honors Physics 9. The units covered will prepare students to take AP Chemistry their junior year. This course is distinguished from the Chemistry course in its faster pace and depth of study, and additional units on acids, bases, and equilibrium.

11th Grade Lab Courses

**BIOLOGY**
This lab course is an investigation of the principles that govern the living world and an introduction to how scientists approach and answer biological problems. The first semester will engage students in the study of the major processes of life through a focus on human physiology. In the second semester students will study ecology and evolution with a macroscopic perspective. The ecology unit will include field studies and a focus on how humans impact the diversity of life. In the second semester students will develop a deep understanding for the evolutionary principles underlying the unity and diversity of life on earth.

**BIOLOGY (Honors)**
This lab course is an investigation of the principles that govern the living world and serves as an introduction to how scientists approach and answer biological problems. The Honors Biology curriculum provides the essential knowledge required to move on to AP biology. It offers an in-depth coverage of the most crucial half of introductory biology: the philosophy of science, biochemistry, the cell and how it harvests energy and reproduces, genetics and genomics, and evolution. This course is a prerequisite for AP biology, which picks up where this class leaves off. Prerequisites: Chemistry, Physics. May be taken concurrently with AP Chemistry.
11th Grade Electives -- Year

AP CHEMISTRY
As a second year chemistry course designed to build upon the successes and knowledge acquisition of first year chemistry. Specifically, AP chemistry designed to analyze chemistry using a mathematical perspective and is equivalent of a first year college general chemistry course. As such, the course is suitable only for high school students who exhibit high levels of commitment, motivation and academic maturity. Additionally, Gilman’s AP chemistry course will be a standards-based blended learning environment. Students must demonstrate a standard of mastery learning on all assessments and labs prior to moving onto the next objectives. As such, students will have multiple opportunities to revise and resubmit work to achieve the set standards. Finally, this course is entirely accessible online, allowing students to determine their own pacing and knowledge acquisition in consultation with their teacher, culminating with sitting for the AP examination in early May and a two week end-of-year project for the final exam.

ENGINEERING
This junior/senior elective is a full-year course with no lab component. Topics covered will include fundamental engineering principles such as design process, material properties, load testing, static equilibrium, basic circuitry, and computer modeling. Students will practice hands-on engineering skills such as 3D printing, spreadsheet programming, data analysis, report writing, and professional-style presentations, all performed in a project-based team setting. Students will gain insight into STEM career opportunities via professional guest speakers and field trips. Class design projects will be geared toward competition in local STEM engineering contests. This course will inspire students to hone their skills in math and science through application to real-world design situations that will challenge their creativity while feeding their curiosity.

11th Grade Electives -- Semester

ROBOTICS II
This semester class is designed for eleventh and twelfth grade students especially interested in robotics, computer science, mechanics and engineering. Students will design and build a robot, learn to program it in java, operate it and train with it in order to participate in the FTC challenge. This is a competition that attracts thousands of high school and middle school teams from around the world. Students will collaborate to understand the problem presented to them, come up with the best design and build a robot out of commercially available parts and raw materials. Students will also sharpen their oral and written expression to communicate their findings. Competitions take place over two Saturdays in January and February and students are required to attend. Priority will be given to students with a demonstrated interest in the field and former members of the robotics course and club. Note: the course may include students from all grades. Since the FTC challenge is different every year, upper classmen may return and participate in the competition again under the course named Robotics III.

12th Grade Gilman Lab Courses

AP BIOLOGY
AP Biology is a college-level lab course that uses the sanctioned AP curriculum and stresses four Big Ideas: 1. Evolution drives the diversity of life. 2. Biological systems utilize energy and molecular building blocks to grow, reproduce, and maintain homeostasis. 3. Living systems store, retrieve, and transmit information. 4. Biological systems interact in complex ways. The course has an emphasis on molecular and cellular biology, including the biochemistry of respiration, photosynthesis, DNA replication, protein synthesis, and genetics. It also emphasizes the process of evolution in creating the diversity of the life on Earth and the relationships between it. AP Biology constitutes the second in a two part series beginning with Honors Biology. Prerequisites: Honors Biology, Chemistry, Physics. May be taken concurrently with AP Chemistry or AP Physics.

AP CHEMISTRY
Please see the description under 11th Grade Electives.

ENIRONMENTAL SUSTAINABILITY
According to the US Census Bureau, 7.3 Billion people inhabit the earth as of January 2017. A 2015 United Nations Report “World Population Prospects” estimates 9.7 billion people by 2050 and 11.2 billion by the end of this century. Consumption of Earth’s finite resources far exceeds human population growth. As a senior elective Environmental Sustainability will draw on the student’s prior knowledge of the core science subjects. The heart of the course will immerse students in environmental impacts and sustainable solutions related to four major concepts: Food, Water, Population, and Energy. Students will develop their understanding through discussion and reading from diverse sources including relevant journal articles, media articles, and books. Students will display their understanding through writing, individual and collaborative projects, and presentations within and beyond the classroom. Students will be expected to delve deeply into the core concepts with a view to developing perspectives, and a solution focused action plan, from apersonal to local to global scale.
12 Grade Course Electives -- Year

### A.P. ENVIRONMENTAL SCIENCE (BMS)
This course is designed to provide students with the scientific principles, concepts, and methodologies required to understand the interrelationships of the natural world, to identify and analyze environmental problems both natural and man-made, to evaluate the relative risks associated with these problems, and to examine alternative solutions for resolving and/or preventing them. Field and laboratory studies, experimental design and data analysis are essential components of the course. Students are expected to learn some material independently. Basic algebraic calculations, dimensional analysis and scientific notation skills to help solve problems will be required. The summer reading required for this course will be announced prior to the end of the current school year. All students must take the Advanced Placement Environmental Science Examination in the spring. (Prerequisites: Biology and Chemistry, AP Biology, Ecology, or Ecology of the Chesapeake Bay may not be taken concurrently.)

### ENGINEERING
Please see the description under 11th Grade Electives.

### NEUROBIOLOGY
Neurobiology studies the biological basis of nervous system structure and function. This senior elective will be taught in the style of a college seminar, and will cover topics ranging from cellular neurophysiology to development to gross nervous system anatomy and clinical correlates. While not a formal lab course, we will use models and demonstrations to introduce the student to the wonders of the brain. Prerequisites: Honors Biology, (any) Chemistry, (any) Physics. May be taken concurrently with AP Biology, AP Chemistry, or AP Physics.

### AP PHYSICS C: MECHANICS
AP Physics C: Mechanics is a calculus based, college-level physics course, especially appropriate for students planning to major in physical science or engineering. The class is meant to be taken as a second course in physics. The course explores topics in mechanics such as kinematics; Newton’s laws of motion; work, energy and power; systems of particles and linear momentum; circular motion and rotation; and oscillations and gravitation. Students will be required to use derivatives and integrals throughout the course, so they must have taken or take concurrently AP calculus AB or BC. The course has a strong hands-on laboratory component where the students will, not only analyze data, but also design their own experiments. Students enrolled in the course are expected to take the AP exam during the second week in May.

### 12 Grade Course Electives – First Semester

#### CIVIL ENGINEERING (RPCS)
In this course, students will explore one of the great challenges of modern urban planning: maintaining a safe and healthy watershed. Topics covered may include providing safe drinking water, developing infrastructure for water transport, and other ways humans impact the hydrology cycle. An emphasis will be on materials design, and major projects may include developing effective water delivery systems and manufacturing materials to improve water quality. (Prerequisites: Physics, Biology, and Chemistry.)

#### ECOLOGY (RPCS)
Chesapeake Bay Ecology and Environmental Policy -- This course provides a comprehensive survey of the ecological that govern the Chesapeake Bay and its watershed. Regular field studies occur in the local watershed of the RPCS stream and the Stony Run stream on the Gilman campus. Having gained an understanding of current conditions and their impact on the Chesapeake Bay, students will focus on environmental policy and propose ways to improve the Bay by governing human use of the local watershed and the bay itself. (Students may not enroll in AP Environmental Science concurrently.)

#### ENGINEERING ENERGY (Honors) (BMS)
This is a project based course that requires independent research. Beginning with the historical and scientific basics of how energy is converted to various forms for use, students will work on group projects explore energy use for heating and electricity generation with experiments using solar cells, wind turbines and hydrogen cells. The engineering of efficiency and conservation of energy in green houses and utilizing biofuel will be analyzed. Students will create personal energy audits independently, will build the most efficient solar systems in groups and design the best wind blades for a wind turbine. Large projects will take the place of the final exam and will include additional topics as nuclear energy, geothermal energy, tidal and wave energy, smart grid technology and power transmission methods.

#### GENETICS/BIOTECHNOLOGY (RPCS)
This course provides the opportunity to complete advanced work in genetics. Topics covered include Mendelian inheritance, molecular biology, genetic engineering, population genetics, and evolution. The uses of biotechnology are a significant part of the course, along with regular study of the social, ethical, and legal implications of recombinant DNA. (Prerequisites: Biology & Chemistry.)

#### NEUROSCIENCE: LEARNING AND THE BRAIN (BMS)
Studies suggest that students who understand something about brain function, the process of learning, and factors that affect it are better learners. A growing body of research demonstrates increasing awareness of the connection between education, the brain function, and cognitive neuroscience. This course will both introduced students to current neuroscience research and provide them with an important understanding of how humans learn, information that should be helpful to them as they move on to a more independent life in college and beyond. Course format will involve collaboration, project-based learning, communication and scientific skills such as data analysis, pattern recognition, and reading current scientific literature. Pre-requisites for course include completion of or concurrent enrollment in physics, biology, and chemistry. Course topics will include brain anatomy, neural networks, neuroplasticity, basic principles of learning, and the impact of emotions and stress on learning.
ROBOTICS III

This semester class is designed for twelfth grade students especially interested in robotics, computer science, mechanics and engineering. Students will design and build a robot, learn to program it in java, operate it and train with it in order to participate in the FTC challenge. This is a competition that attracts thousands of high school and middle school teams from around the world. Students will collaborate to understand the problem presented to them, come up with the best design and build a robot out of commercially available parts and raw materials. Students will also sharpen their oral and written expression to communicate their findings. Competitions take place over two Saturdays in January and February and students are required to attend. Priority will be given to students with a demonstrated interest in the field and former members of the robotics course and club. Note: the course may include students from all grades. Since the FTC challenge is different every year, upper classmen may return and participate in the competition again under the course named Robotics III.

12 Grade Course Electives – Second Semester

ANATOMY AND PHYSIOLOGY
This course provides a survey of various systems of the human body with an emphasis on their physiology. The workings of the various organs and their interactions will be examined and extensive laboratory work will be completed, which may include dissections. (Prerequisite: Biology and Chemistry.)

APPLIED CHEMISTRY
This course will provide the chance to apply concepts learned in a first year chemistry course to ‘real world” problems. Following a review of basic chemical concepts, students will be introduced to applications and explorations such as those found in 2-dimensional art, the food industry, consumer products, and the production of common pharmaceuticals such as aspirin. Students will also have the opportunity to gain an understanding of how flavors and fragrances are created through an introduction to the analysis and practical uses of organic compounds.. (Prerequisite: Chemistry)

ENGINEERING PRINCIPLES
This course introduces students to a variety of engineering disciplines while encouraging student creativity and collaboration. Students will become acquainted with the foundations of technical drawing and will use their knowledge to prepare blueprints of their projects in the structural engineering unit. Students will develop an understanding of the properties of materials and the analysis of forces on a structure before embarking on their own design projects. Projects will include analyzing tall buildings, bridges, sails and flying structures. And these projects will introduce students to the iterative nature of the design process.

IMMUNOLOGY
How does the Ebola virus differ from the common cold? What causes allergies? Why are some bacterial infections more difficult to cure than others? How do vaccines work? This course provides the opportunity to learn the answers to these and other related questions as it explores how the human immune system works. Students will study the processes used to identify and respond to pathogens, and they will gain hands-on experience through laboratory experiments such as the ELISA test.

SUSTAINABLE DESIGN
The goal of sustainable design is to produce products, processes, and services in a way that reduces use of non-renewable resources, minimizes environmental impact, and connects people with the natural environment. Engineering is the interface between science, technology, and the economy. Economic considerations have always been an integral part of engineering design, and sustainable design incorporates environmental considerations into the equation. In this course, students will learn about sustainable design concepts such as Life Cycle Assessment – a technique to assess the environmental aspects and potential impacts associated with a product, process, or service by compiling an inventory of energy and material inputs and environmental releases. Projects may include designing model solar cars, wind turbines, and/or other alternative energy devices. Students will also focus on ways to make the RPCS campus a learning tool for the entire community.