

The science program provides students with the opportunity to take courses from those listed below:

SCIENCE DEPARTMENT CURRICULUM OFFERINGS

Grade 9 SC-111 Honors Biology
 SC-102 Environmental Earth Science

Grade 10 SC-211 Honors Biology
 SC-212 Biology

Grade 11 SC-313 Action Chemistry
 SC-321 Honors Chemistry
 SC-322 Chemistry
 SC-432 Physics
 SC-342 Environmental Science
 SC-344 Geophysics

ADVANCED PLACEMENT SCIENCES AND PROJECT ACCELERATION

SC-310 Advanced Placement Biology
SC-420 Advanced Placement Chemistry
SC-430 Advanced Placement Physics 1
SC-530 Advanced Placement Physics 2

STEM ELECTIVES

SC-150 Introduction to Engineering
SC-250 Principles of Engineering
SC-350 Digital Electronics

ELECTIVES

SC-443 Human Anatomy & Physiology
SC-444 Forensic Science
SC-445 Hollywood Science

SCIENCE DEPARTMENT

INTRODUCTION

The Science Department of Union High School offers a diversified curriculum in both the biological and physical sciences. In order to satisfy the three-year, state-mandated science requirement and/or for College admission students will be required to successfully complete Biology and either Chemistry, Action Chemistry, Environmental Science or Physics and a third year lab science course.

Courses are available for the pupil who has a keen interest in science and may be contemplating a future vocation

in engineering, environmental science, medicine, dentistry, nursing or one of the other health related careers. It is extremely important in this present day and age for young people to become familiar with the various areas of science, as many important issues of society will involve being knowledgeable about the basic concepts and principles of the biological and physical sciences. We have to be literate in science, if we are going to live and survive in the "**AGE OF SCIENTIFIC INVESTIGATION, EXPLORATION AND TECHNOLOGY**" in the 21st century.

\$\$\$ SAVING OF MONEY FOR COLLEGE TUITION \$\$\$
EARNING OF COLLEGE CREDITS AND/OR
ADVANCED STANDING

At Union High School there are TWO programs in science whereby qualified pupils may be SELECTED to take college level courses for **DEGREE CREDIT AND/OR ADVANCED STANDING**. With these programs, **IT IS POSSIBLE** for students to be awarded "**SOPHOMORE STANDING**" at the colleges or universities of their choices.

The programs are: (1) ADVANCED PLACEMENT (2) PROJECT ACCELERATION

THE ADVANCED PLACEMENT SCIENCE PROGRAM

Most interested and qualified pupils would take only one or two advanced science courses during their high school careers. Students would make a choice of **ADVANCED PLACEMENT BIOLOGY** **ADVANCED PLACEMENT CHEMISTRY** for their **SENIOR** year program. Juniors may elect to take **A.P. BIOLOGY IN CONJUNCTION WITH HONORS CHEMISTRY**. The only preparation necessary would be to have completed the first year of the subject prior to the senior year. The standard course of Biology is usually taken in the 10th grade. Chemistry is taken in the 11th grade. Therefore, if students were to select Advanced Placement Chemistry, during their senior year, they would have completed two semesters of Chemistry in their junior year. **ALL STUDENTS WHO ARE TAKING ANY ADVANCED SCIENCE COURSE MUST COMPLETE FULL YEAR OF EACH OF THE INTRODUCTORY SCIENCE COURSES OF BIOLOGY, CHEMISTRY AND PHYSICS.**

When in attendance at the high school, students **MUST COMPLETE A FORMAL APPLICATION** for each of the advanced courses they wish to take. In other words, all students must **APPLY FOR ADMISSION** to an advanced science course and be accepted. Applications are to be submitted to the Supervisor of Science.

PROJECT ACCELERATION

Project Acceleration is a cooperative arrangement between Seton Hall University and a select number of New Jersey high schools, including Union High School. The program will give qualified high school students the opportunity to earn a **TOTAL OF TWENTY-TWO (22) COLLEGE CREDITS** during his/her four (4) years of high school for a nominal fee.

Upon the student's satisfactory completion of the program and being graduated from high school, Seton Hall University will issue an official transcript with the grade(s) and credits earned for the course(s) taken.

Qualified high school faculty members, whose academic credentials have been approved by the University, have been granted adjunct faculty status at Seton Hall. They teach the approved courses at the **HIGH SCHOOL** as part of their regular teaching schedule. Courses taught are college level in nature and are equivalent to the extensive offerings available to freshmen at Seton Hall. NOT ALL COLLEGES WILL ACCEPT THE CREDITS FROM SETON HALL UNIVERSITY.

PROJECT ACCELERATION is NOT intended to replace the **Advanced Placement Program**, but to offer students an alternative way to earn college credits and/or placement while attending high school.

The following courses of the Science Department have been approved by Seton Hall University to be part of

Project Acceleration.

- (1) Advanced Placement Biology (SC-310) - 1 year course - 7 credits
- (2) Advanced Placement Chemistry (SC-420) - 1 year course - 7 credits
- (3) Advanced Placement Physics (SC-430) - 1 year course - 7 credits

SCIENCE DEPARTMENT - COURSE OFFERINGS

SC 102 Environmental Earth Science

The ninth grade Science Curriculum is a continuum of the seventh and eighth grade courses. It elaborates upon and deepens the concepts of environmental and earth science and is designed to immerse students in the physical, biological and earth systems sciences that shape our planet and the environment we live in. Scientific concepts, principals, and modern science practices allow students to analyze the earth and the many processes that shape it as well as exploring beyond earth and the formation of the universe. Environmental issues, both natural and human induced will be studied, and are designed to engage students in evidence-based decision making in real world contexts.

SC-111/211 Honors Biology

Honors Biology is specifically designed for the student who has demonstrated exceptional ability in the sciences and who is contemplating the attending of a four-year college upon graduation from high school. It is strongly recommended that this course be selected if a student is contemplating the taking of Advanced Placement Biology. The course will challenge the more able student with a rigorous, in-depth study of biology, stressing higher-levels of learning and critical thinking skills. It will emphasize the scientific vocabulary of biology as well as some of the more abstract concepts of molecular and cellular biology.

The subject matter included in the first half will be: the characteristics of all living things, the chemical and structural bases of life, the cell and the environment, photosynthesis, cellular respiration, protein synthesis, cellular reproduction and heredity.

The second half of Honors Biology will use the basic concepts and information taught and discussed in the first semester to explore the relationships between the structure and function of the different systems of humans. The students of Honors Biology will perform extensive laboratory experiences which will be open-ended and designed to foster discovery skills and investigative procedures.

Laboratory investigations including computer simulations and demonstrations using electronic/physiological equipment will be utilized to demonstrate the anatomy and physiology of the human body.

The evolution and classification of organisms protozoa, will be studied, as well as various microscopic forms of life, such as viruses, bacteria, fungi, and algae will be studied. The plant kingdom will also be investigated, with emphasis being placed upon the anatomy and physiology of the seed plants.

Principles of ecology will be presented, if time permits

SC-212 Biology

Biology is a lab science course that emphasizes the scientific vocabulary of biology as well as some of the more abstract concepts of molecular and cellular biology.

The subject matter included in the first semester will be as follows: the characteristics of all living things, the

chemical and structural basis of life, the cell and its environment, photosynthesis and cellular respiration, ecology. The second half of the year will emphasize DNA and protein synthesis, cell reproduction, genetics and heredity, principles of evolution, origin of humans, classification of organisms and the exploration of diversity on earth.

SC-432 Physics

The course is a study of the relationships between matter and energy, the course begins with an investigation of the relationships of length, time and mass in terms of basic quantities. The semester ends with an application of the above foundation to thermal energy. Since the language of physics is mathematics, solving problems of a mathematical nature will be emphasized.

Topics to be included in the first semester will be: 1) the meaning of Physics 2) the mathematics of physics, motion, velocity, acceleration, forces, vectors, motion in two dimensions, universal gravitation, momentum and its conservation, work, energy, and simple machines, energy, thermal energy, and the states of matter.

The second half of the year builds upon the foundation of the first half and begins with the study of electricity and magnetism and ends with the study of waves and their application to sound and optics. If time permits, the basics of nuclear science will be presented. Problem solving, once again, will be emphasized.

Topics to be included in the second half will be: static electricity, electric fields, current electricity, series and parallel circuits, magnetic fields, electromagnetic induction, electric and magnetic fields, waves and energy transfer, sound, light, reflection and refraction, mirrors and lenses, diffraction and interference of light, and nuclear energy when time permits.

SC- 322 Chemistry

Enrollment: Juniors and Seniors

Prerequisites: Must have completed Algebra I and Geometry with no grades less than a 2 (two) or have permission from the Supervisor of Science.

Chemistry is designed for the student who is contemplating a future career or major in the sciences and/or a science related field and has a good and adequate background in mathematics. It is a theoretical and mathematical approach to the study of the composition and activity of the various elements and compounds found on the Physical.

The first half will establish the basic and fundamental concepts for the organized study of matter. It will involve the learning and understanding of the metric system, properties of matter and the energy relationships between the atomic particles in matter which are responsible for chemical bonding. Students will then be able to apply these concepts to the writing of chemical formulae and balanced equations. In addition, the "Mole Concept" will be introduced.

Utilizing the concepts and theories learned in the two quarters, the students will learn how to solve problems of various types which illustrate the mathematical relationships which exist in chemistry. Through classroom discussions and laboratory experiments, the students will learn about the physical and chemical properties of acids and bases. This will include the topics of pH, molarity, molality and acid-base titration as well as the theories concerning the nature of these two kinds of substances. A study of the energy of reactions will be included. The year will conclude with an introduction to the subject of chemical equilibrium with the emphasis being placed upon the equilibrium constant, the predicting chemical activity. Calculations involving these concepts will also be presented.

SC – 313 Action Chemistry

Enrollment: Juniors and Seniors

Prerequisites: Must have completed Algebra

A full year, high school course in chemistry. It is a lab science course.

The first half will begin with the study of matter. It will involve the learning of the metric system; properties of matter and the relationship between the atomic particles in matter which are responsible for chemical bonding. Students will then be able to apply these concepts to the writing of chemical formulae and balanced equations. In addition the "Mole Concept" will be introduced.

The second half builds upon the concepts learned in the previous semester. Through laboratory experiments, the students will learn about the physical and chemical properties of acids and bases. This will include the topics of pH and solution chemistry. Students will investigate the Periodic Table and it uses to predict the physical and chemical activity of the elements.

SC-321 Honors Chemistry

Enrollment: Sophomores, Juniors and Seniors

Prerequisites: Students must have completed Algebra II and Trigonometry before taking this course with a grade of A or better or permission from the Supervisor of Science. This course is designed for the more able student who has a very strong aptitude for mathematics.

Honors Chemistry is designed for the student who is contemplating a future career or major in science and has a good and adequate background in mathematics. It is a theoretical and mathematical approach to the study of the composition and activity of the various elements and compounds found on the Physical.

The first half will establish the basic and fundamental concepts for the organized study of matter. It will involve the learning and understanding of valences of elements and the energy relationships required to form different types of chemical formulae and the uniting of balanced equations. The students will learn how to solve problems of various types which illustrate the mathematical relationships which exist in chemistry. Emphasis will be placed upon the "**Mole Concept**." The solution process will be investigated together with the theory and concepts of ionization as well as the gas laws and their mathematical relationships.

Through classroom discussions and laboratory experiments, the students will learn about the physical and chemical properties of acids and bases. This will include the topics of pH, molarity, molality and acid-base titration as well as the theories concerning the nature of acids and bases. A study of the energy of reactions will be included. The year will conclude with an introduction to the subject of chemical equilibrium with the emphasis being placed upon the equilibrium constant, the ionization constant and the solubility product, as methods of explaining and predicting chemical activity. Calculations involving these concepts will be presented. Students will be exposed to the concepts of nuclear chemistry by doing written reports and oral presentations.

SC-322 Chemistry

Enrollment: Juniors and Seniors

Prerequisites: Must have completed Algebra I and Geometry with no grades less than a 2 (two) or have permission from the Director of Science.

Chemistry is designed for the student who is contemplating a future career or major in the sciences and/or a science related field and has a good and adequate background in mathematics. It is a theoretical and mathematical approach to the study of the composition and activity of the various elements and compounds found on the Physical.

The first half will establish the basic and fundamental concepts for the organized study of matter. It will involve the learning and understanding of the metric system, properties of matter and the energy relationships between the

atomic particles in matter which are responsible for chemical bonding. Students will then be able to apply these concepts to the writing of chemical formulae and balanced equations. In addition, the "Mole Concept" will be introduced.

Utilizing the concepts and theories learned in the two quarters, the students will learn how to solve problems of various types which illustrate the mathematical relationships which exist in chemistry. Through classroom discussions and laboratory experiments, the students will learn about the physical and chemical properties of acids and bases. This will include the topics of pH, molarity, molality and acid-base titration as well as the theories concerning the nature of these two kinds of substances. A study of the energy of reactions will be included. The year will conclude with an introduction to the subject of chemical equilibrium with the emphasis being placed upon the equilibrium constant, the predicting chemical activity. Calculations involving these concepts will also be presented.

SC-342 Environmental Science

Enrollment: Juniors and Seniors

This is a hands-on course. We will be investigating the relationships among plants, animals and the environment through lab work, outdoor field studies and class discussions. The subject matter to be included in this course will be organisms and their relationships to their environment, energy in an ecosystem and the different types of terrestrial ecosystems. Current problems concerning the environment will be dealt with in this course.

During this second half of the year we will build on concepts dealt with in semester one. Particular emphasis will be placed on bodies of fresh water, pollution and human population, both locally and worldwide. An outdoor field trip will reinforce the concepts learned throughout the year.

SC-344 Geophysics

Enrollment: Juniors and Seniors

It is an integrated science course which will include topics from all of the sciences. Life science, environmental science, chemistry, physical and earth science will be investigated through hands-on activities. It is a lab science course. This course is typically for those students that are not pursuing science in college.

ADVANCED PLACEMENT SCIENCES AND PROJECT ACCELERATION

SC-310 Advanced Placement Biology

Enrollment: Juniors and Seniors (recommendation by supervisor)

Prerequisites: SC-211 and SC-321: Juniors who are planning to take advanced placement sciences must be taking SC-321 or SC432 simultaneously; seniors must be taking SC-431, unless previously taken as a junior.

The first half of the full year, COLLEGE-LEVEL COURSE in biology is designed to prepare students to take the **Advanced Placement Examination** for college degree credit and/or advanced placement. The subject matter included will be the origin of life, the study of basic chemistry and biochemistry, cells, enzymes, energy transformations, cellular division, the chemical nature of the gene and genetics.

The second half of Advanced Placement Biology will utilize the basic concepts and theories taught and discussed in the first semester to investigate and to explore the structure and function of organ systems in animals, with the emphasis being placed upon the vertebrates. Also included will be the structure and function of organ systems of

plants, with emphasis being placed upon the angiosperms, plant reproduction and development, the principles of ecology, evolution, behavior and social biology.

SC-310 L Advanced Placement Biology Laboratory

Enrollment: Juniors and Seniors currently enrolled in Advanced Placement Biology (SC-310)

This is the laboratory component of SC-310. Students will perform the following investigations and/or experiments which are mandated by the College Board's Advanced Placement Biology Examination Committee: microscope utilization and measurement, catalysis, mitosis and meiosis, plant pigments and photosynthesis, cell respiration, molecular biology (gene splicing), genetics of drosophila, population genetics and evolution, transpiration, physiology of the circulatory system, behavior: habitat selection, dissolved oxygen and primary productivity and a fetal pig dissection. Optional topics include: detailed microscopic study of animal and plant tissues and muscle physiology.

SC-420 Advanced Placement Chemistry

Prerequisite: SC-321 or SC-322 and Algebra II/Trigonometry with no grades below a 3 (three).

A sequential, full year, college level course in chemistry which is designed to prepare students to take the Advanced Placement Examination for college degree credit and/or advanced placement.

The first half of advanced chemistry deals with the basic concepts of chemistry already discussed in the first year of chemistry. Concepts covered include stoichiometry, atomic structure, chemical bonding, the periodic table, liquids, gases, solids and solution processes.

The second half of the year will concern itself with discussions and problem-solving activities which will focus upon chemical reactions, how they occur and what will affect such chemical behavior. Students will investigate the subjects acids/bases of heats of reactions, solubility products, equilibrium and ionization constants, redox reactions and basic qualitative analysis.

SC-420L Advanced Placement Chemistry Laboratory

Enrollment: Juniors and Seniors currently enrolled in Advanced Placement Chemistry (SC-420)

Laboratory instrumentation and experimentation will reinforce classroom learning experiences.

SC-430 Advanced Placement Physics 1

AP Physics 1 is an algebra-based, introductory college-level physics course that explores topics such as Newtonian mechanics (including rotational motion); work, energy, and power; mechanical waves and sound; and introductory, simple circuits. Through inquiry-based learning, students will develop scientific critical thinking and reasoning skills.

SC-530 Advanced Placement Physics 2

AP Physics 2 is an algebra-based, introductory college-level physics course that explores topics such as fluid statics and dynamics; thermodynamics with kinetic theory; PV diagrams and probability; electrostatics, electrical circuits with capacitors; magnetic fields; electromagnetism; physical and geometrical optics; and quantum, atomic, and nuclear physics. Through inquiry-based learning, students will develop scientific critical thinking and reasoning skills.

ADDITIONAL SCIENCE COURSES - ELECTIVES

SC-443 Human Anatomy and Physiology

Enrollment: **Seniors only Prerequisite: THREE YEARS OF SCIENCE**

This course will introduce the student to the basic principles of human anatomy and physiology. Students will investigate the skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, urinary and reproductive systems. Numerous laboratory exercises including blood pressure, pulse, reflexes, EKG, sheep

brain dissection, sheep heart dissection, and fetal pig dissection. Audio and visual materials, models, demonstrations and lectures will be utilized to demonstrate the relationships of the structures and mechanisms of each system to the functions of the entire human body. The course will conclude with an extensive fetal pig dissection and practicum.

SC-444 Forensic Science (Seniors only)

Prerequisite: THREE YEARS OF SCIENCE

This course will be 80-90% laboratory based. Students will be learning and implementing the newest lab techniques in the area of forensics such as DNA fingerprinting, blood analysis, hair and fiber identification, document and voice examination.

SC-445 Hollywood Science (Seniors only)

Prerequisite: THREE YEARS OF SCIENCE

This course is a full semester course for seniors. The use of film clips from movies such as Jurassic Park, Forest Gump, Men in Black, The Day After Tomorrow, Twister and various others will be viewed as a means to explore concepts and principles in the sciences. Topics in Biology, Earth Science, Chemistry, Physics, Nuclear Science and Environmental Science will be discussed during the course of the year.

STEM ELECTIVES

The Project Lead the Way Pathway to Engineering program is a sequence of courses, which follows a proven hands-on, real-world problem-solving approach to learning. Throughout PTE, students learn and apply the design process, acquire strong teamwork and communication proficiency and develop organizational, critical-thinking, and problem-solving skills. They discover the answers to questions like how are things made and what processes go into creating products? Students use the same industry-leading 3D design software used by companies like Intel, Lockheed Martin and Pixar. They explore aerodynamics, astronautics and space life sciences. Hello, NASA. Students apply biological and engineering concepts related to biomechanics – think robotics. They design, test and actually construct circuits and devices such as smart phones and tablets and work collaboratively on a culminating capstone project. It's STEM education and it's at the heart of today's high-tech, high-skill global economy.

SC-150 Introduction to Engineering Design (STEM)

Enrollment: open to all students

The major focus of IED is the design process and its application. Through hands-on projects, students apply engineering standards and document their work. Students use industry standard 3D modeling software to help them design solutions to solve proposed problems, document their work using an engineer's notebook, and communicate solutions to peers and members of the professional community.

SC-250 Principles of Engineering (STEM)

Pre-requisite: Introduction to Engineering Design

This survey course exposes students to major concepts they'll encounter in a post-secondary engineering course of study. Topics include mechanisms, energy, statics, materials, and kinematics. They develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges, document their work and communicate solutions.

SC-350 Digital Electronics (STEM)

Pre-requisite: Principles of Engineering

Third year course. Digital electronics is the foundation of all modern electronic devices such as mobile phones,

MP3 players, laptop computers, digital cameras and high-definition televisions. Students are introduced to the process of combinational and sequential logic design, engineering standards and technical documentation.