

# SCIENCE SEQUENCE

9th	Foundations of Physics	Freshman Physics	Honors Freshman Physics
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10th	Foundations of Chemistry	Chemistry	Honors Chemistry
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11th	Foundations of Biology	Biology	Honors Biology
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11th – 12th	<b>Additional Junior and Senior Course Options</b>		
	AP Biology (Full Year)		
	AP Chemistry (Full Year)		
	AP Environmental Science (Full Year)		
	AP Physics I (Full Year)		
	AP Physics II (Full Year)		
	Anatomy and Physiology (Full Year)		
	Solar System Astronomy (One Semester)		
	Cosmology: Origins of the Universe (One Semester)		
	Evolution (One Semester)		
	Forensic Science (One Semester)		
	Advanced Forensic Science (One Semester)		
	Physics (Full Year)		
	Plant Science (One Semester)		
	Science Career Seminar (One Semester)		

## PROJECT LEAD THE WAY

(ELECTIVE CREDIT – NOT FOR SCIENCE CREDIT)

- Principles of Biomedical Science (Full Year - Grades 9-12) – **page 65**
- Human Body Systems (Full Year - Grades 10-12) – **page 66**
- Medical Interventions (Full Year - Grades 11-12) – **page 66**
- Biomedical Innovation (Full Year - Grade 11-12) – **page 67**

# Clayton Science Enduring Understandings

Students in the Clayton School District  
will understand the following  
big ideas presented throughout their K-12 science classes:

## 1. The systematic nature of all things

*All things in nature are made up of interacting and interdependent parts. Everything is a part in a larger system.*

## 2. The interaction between energy and matter that flow through systems

*All things in nature interact with and are affected by energy. The total amount of energy and matter in the universe remains constant.*

## 3. The nature of stability, change and equilibrium

*All things in nature change over time in order to reach a balance (equilibrium), however, systems can show stability over long periods of time.*

## 4. The relationship between structure and function

*The way things are put together determines what they can do. The way a system works depends on what it is made of and on the shapes and forms of its parts.*

## 5. The creation of models to represent abstract ideas and phenomena

*In order to understand how systems function and the patterns observed in nature, people develop models that describe how nature works. Many models are quantified using mathematics.*

## 6. The process of scientific reasoning and the evaluation of ideas

*Advances in science start with observations that lead to questions that are answered by experimentation and modeling. Measurements of observations lead to a mathematical treatment of data.*

## 7. The interaction between science and society

*As a result of scientific pursuits, human beings have developed an understanding of nature that has affected all people's lives in many ways.*

The Missouri Department of Elementary and Secondary Education requires high school graduates to earn three units of credit selected to ensure that students have mastered the unifying concepts, principles, and laws common to all the sciences; can competently apply scientific practices; and can organize and solve scientific problems in the consumer, career, and technical environments. At Clayton High School this is accomplished through college preparatory physics, chemistry, and biology. Most CHS students enroll in science courses all four years.

Science courses typically alternate between a standard 47 minute period and an extended “lab” period that meets for 74 minutes. All courses are laboratory oriented and include investigations that give students experience in collecting, organizing, graphically representing, analyzing, and interpreting data. At its core, the CHS science experience is designed to help students understand science as a process of evidence-based discovery that facilitates the understanding of natural phenomena.

Placement recommendations are tailored to needs and abilities so each student is challenged every year. To this end, a wide variety of science experiences are available. Freshmen are recommended for Foundations of Physics, Freshman Physics, or Honors Freshman Physics based on aptitude in 8th grade science and math, performance on a reasoning test, and scores on the ASPIRE test. Sophomores are recommended for Foundations of Chemistry, Chemistry, or Honors Chemistry based on performance and aptitude in their physics course. Juniors are recommended for Foundations of Biology, Biology, Honors Biology, or AP Biology based on performance and aptitude in their chemistry course. Juniors often take a science elective concurrently with their Biology course. Students who have completed Honors Chemistry may be recommended to take both AP Biology and AP Chemistry as a combined, three-period block during their junior year. Seniors are recommended for science electives and/or AP science courses based on performance and aptitude displayed during their junior year. Students who do not meet specific course prerequisites may occasionally be enrolled in a class with the consent of the instructor.

## **FOUNDATIONS OF PHYSICS**

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9th Grade  
Credit - 1  
Full Year

**Prerequisite: Enrollment requires departmental approval**

Foundations of Physics is an adapted version of Freshman Physics for a select group of students who will benefit from a modified pace and depth of content. The course is designed to build the science and math skills of students in preparation for the rest of their high school experience. Students will gain conceptual understandings of motion, forces, energy, and electricity. Students develop scientific models to describe the physical world by analyzing the results of laboratory experiments. The skills of experimental design, data collection, and graphical analysis will be emphasized. Students will demonstrate their understanding verbally, diagrammatically, graphically, and algebraically. **(This course does not qualify for NCAA eligibility.)**

## **FRESHMAN PHYSICS**

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9th Grade  
Credit - 1  
Full Year

Freshman Physics is an introductory course to the formal study of the physical sciences. Students will develop conceptual understanding of electricity, motion, forces, energy, and waves. Students will learn to build scientific models to describe the physical world by analyzing the results of laboratory experiments. The skills of experimental design, data collection, and graphical analysis will be emphasized. Students will express these models verbally, diagrammatically, graphically, and algebraically. Students will build a laboratory portfolio, which includes results of each of the major investigations throughout the year.

## **HONORS FRESHMAN PHYSICS**

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9th Grade

Credit - 1

Full Year

**Prerequisite: Enrollment requires departmental approval.**

Honors Freshman Physics is an introductory course to a formal study of the physical sciences with emphasis on mathematical problem solving. Students will develop major concepts in motion, forces, energy, electricity, and wave motion. Students will learn to build scientific models to describe the physical world by analyzing the results of laboratory experiments. The skills of experimental design, data collection, and graphical analysis will be emphasized. Students will express these models verbally, diagrammatically, graphically, and algebraically. This course moves at an accelerated pace and it requires excellent reasoning skills and well-developed work and study habits. Fluency in the application of algebra is essential. Students will build a laboratory portfolio, which includes results of each of the major investigations throughout the year.

## **FOUNDATIONS OF CHEMISTRY**

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10th Grade

Credit - 1

Full Year

**Prerequisite: Enrollment requires departmental approval.**

What is the nature of matter? How does matter change? Why does matter change? How do changes in the world around us affect our lives? How does one system affect another? Students will investigate these questions and others through a variety of “hands-on” and written experiences as they explore how science is relevant to daily life. Students will develop an awareness of the potential and the limitations of science and technology. Activities will include reading, writing, discussion, laboratory activities, laboratory reports, and student projects. Students will frequently work together in teams. Critical thinking (the ability to carry out systematic thought processes in making decisions and solving problems), inquiry (solving problems through scientific investigation), science ethics, and the nature of science are stressed in this class (**This course does not qualify for NCAA eligibility.**)

## **CHEMISTRY**

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10th Grade

Credit - 1

Full Year

This course introduces important concepts of chemistry while applying these concepts to the students' everyday lives and experiences. Topics addressed include basic problem solving, scientific measurement, states of matter, atomic structure, the periodic table, chemical formula writing, chemical reactions, gas behavior, stoichiometry, chemical bonding, thermochemistry, acids and bases, and nuclear chemistry. Activities include laboratory experiences, discussion, reading, writing, laboratory reports, and student projects. Students will frequently work together in teams. Basic algebra skills are required.

## **HONORS CHEMISTRY**

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10th Grade

Credit - 1

Full Year

**Prerequisite: Enrollment requires departmental approval**

The models and theories of chemistry are developed in this course. Considerable emphasis is placed on the student's ability to interpret data, solve problems, and use higher-order thinking skills. The core topics include models for atoms, bonding theory, chemical reactions, kinetic molecular theory, gas behavior, thermochemistry, chemical bonding, rates of reactions, equilibrium, and acids and bases. We will connect the topics of the course to everyday life and current news events whenever possible. The course will include reading, lecture/discussion, laboratory activities, and problem solving. This course is designed for students who have demonstrated success in honors mathematics and science courses. Laboratory reports will be required and homework assignments are given daily. Each student needs a scientific calculator. A college level text is used.

## **FOUNDATIONS OF BIOLOGY**

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11th Grade

Credit - 1

Full Year

**Prerequisite: Enrollment requires departmental approval**

This course emphasizes an inquiry-based exploration of living organisms; how they function, interact, and evolve. Students will develop and conduct experiments, collect data, and analyze data throughout the year. This exploration allows students to ask questions about the world around them, work on problem solving strategies, think critically, and develop their understanding of science as a process. The main goal of this course is for students to explain phenomena encountered in their everyday lives and to develop a thoughtful and well-reasoned understanding of the living world. **(This course does not qualify for NCAA eligibility.)**

## **BIOLOGY**

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11th Grade

Credit - 1

Full Year

Biology takes a cellular and molecular approach to understanding the unity and diversity of the living world. The course begins by investigating the nature of chemical reactions in living systems and the biomolecules involved. This serves as a foundation for the exploration of cell structure and function, energy conversions, the cell cycle, genetics, gene expression, evolution, and culminates in understanding the flow of energy and cycling of matter in organisms and ecosystems. Students will design and implement experiments, gather data, and perform data analysis to deepen their conceptual understandings of course content.

## **HONORS BIOLOGY**

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11th Grade

Credit - 1

Full Year

**Prerequisite: Enrollment requires departmental approval**

Honors Biology takes a cellular and molecular approach in exploring the living world. Twelve core themes are interwoven throughout the course to build a holistic understanding of the essential elements of modern biology. These themes include: biochemistry, metabolism, cellular transport, cell structure & function, energy flow through living systems, transport systems of life, cell reproduction, gene expression, genetics, ecology, evolution, and paleobiogeography. Learning of content material is enriched through inquiry-based experimental design, data collection, and data analysis. Honors Biology is a good fit for students who are adept at scientific reasoning, fluid at learning conceptually, have excellent study habits, and have a record of academic excellence in previous science courses.

## **AP BIOLOGY**

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11th - 12th Grade

Credit - 1

Full Year

**Prerequisite: Honors Chemistry, Honors Biology, or departmental approval.**

Advanced Placement (AP) Biology is an in-depth study of living systems. The curriculum is equivalent to that of a first-year college course in the biological sciences. Conceptual emphasis is placed on biochemistry, cell biology, genetics, molecular biology, evolution, and ecology; moreover, the interconnectedness of these topics is underscored throughout the course. The classroom experience allows students to work independently with AP science practices which include hypothesis generation, experimental design, statistical analysis of data, and writing scientific explanations. Students will improve their critical thinking skills by interpreting data from the scientific literature and through this experience become more familiar with contemporary biological issues. Students are expected to take the AP Biology exam in May.

## **AP CHEMISTRY**

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11th - 12th Grade

Credit - 1

Full Year

**Prerequisite: Honors Chemistry or departmental approval.**

This course is designed to be the equivalent of the general chemistry course usually taken during the first year of college. Students will experience depth and breadth of understanding of chemical fundamentals, competence in dealing with chemical calculations, and experience in the nature and variety of laboratory experiments equivalent to that of a typical college course. Topics such as the atomic and molecular structure of matter, kinetic theory of gases, chemical equilibrium, chemical kinetics, electrochemistry, and basic principles of thermodynamics are emphasized. A substantial portion of class time is spent on understanding and applying these concepts through chemical problem solving. Students develop the ability to think clearly and to express their ideas in writing with clarity and logic. In addition, the behavior of chemical systems is investigated in the laboratory. Students will develop a laboratory portfolio from reports that are submitted for each experiment. Each student is expected to take the AP Chemistry exam in May.

## **AP ENVIRONMENTAL SCIENCE**

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11th - 12th Grade

Credit - 1

Full Year (Unlike other full-year science courses, AP Environmental Science does not have an extended lab period.)

**Prerequisite: Honors Chemistry, Honors Biology, AP Biology, concurrent enrollment in Honors or AP Biology, or departmental approval.**

In AP Environmental Science students will investigate the nature of Earth systems (ecology, geology, climate, etc.), historical and current human impacts on Earth systems, ways to decrease human impacts on Earth systems, ongoing efforts to preserve biodiversity and repair past damage, and options for leading a more sustainable way of life. The lab experience includes hypothesis generation, experimental design and implementation, the process of peer review, graphical organization and statistical analysis of data, and the use of mathematical models to represent natural phenomena. Higher order cognitive skills will be grown through the use of science as a process to develop an evidence-based understanding of nature, identification of logical fallacies, critical examination of commonly held assumptions about the environment, and scrutinizing the relationship between science and public policy. Students should be skilled in Algebra, capable of comprehending a college-level science text, and willing to devote study time to APES on a daily basis. Students are expected to take the AP Environmental Science exam in May.

## **AP PHYSICS I**

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11th – 12th Grade

Credit – 1

Full Year

**Prerequisite: Excellent skills in Algebra, at least concurrent enrollment in Geometry, or by departmental approval**

AP Physics I is a rigorous treatment of the classical physics areas of mechanics, mechanical waves, and introductory electric circuits. It is the equivalent of a typical first semester, algebra-based college physics course. Physical models will be developed through laboratory investigation in the areas of one and two-dimensional kinematics, Newton's laws, energy, circular motion, gravitation, linear momentum, rotational motion, oscillations, mechanical waves, sound, and introductory electric circuits. Students will submit lab reports for each laboratory investigation. Students will be required to solve problems mathematically, with extensive use of proportional and symbolic reasoning. The ability to translate between multiple representations of physical models will be emphasized. The course is designed to provide excellent preparation for students considering the study of science, medicine, or engineering in college. Students who successfully complete the course will be well-prepared for, and expected to take, the College Board Advanced Placement Physics I examination in May. Except when recommended by the instructor, students should have successfully completed Freshman Physics or Honors Freshman Physics prior to enrollment in AP Physics I.

## **AP PHYSICS II**

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11th – 12th Grade

Credit – 1

Full Year

**Prerequisites: Algebra, Geometry, Algebra II, and Trigonometry. Students who take this class must be concurrently enrolled in, or have previously completed AP Physics I, or by department approval**

AP Physics II is a rigorous treatment of fluid statics and dynamics, thermodynamics with kinetic theory, electrostatics, electric circuits, magnetic fields, electromagnetism, geometric and physical optics, and topics in modern physics. It is the equivalent of a typical second semester, algebra-based, college physics course. Physical models in the areas listed above will be developed through laboratory investigation. Students will submit lab reports for each laboratory investigation. Students will be required to solve problems mathematically with extensive use of proportional and symbolic reasoning. The ability to translate between multiple representations of physical models will be emphasized. The course is designed to provide excellent preparation for students considering the study of science, medicine, or engineering in college. Students who successfully complete the course will be well-prepared for, and expected to take, the College Board Advanced Placement Physics II examination in May.

## **ANATOMY AND PHYSIOLOGY**

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11th - 12th Grade

Credit - 1

One Year (Unlike other full-year science courses, Anatomy & Physiology does not have an extended lab period.)

**Prerequisite: Project Lead the Way Principles of Biomedical Science, Honors Biology or departmental approval.**

Anatomy and Physiology is geared to upperclassmen preparing for study in health-related areas. Students will engage in the study of the processes, structures, and interactions of human body systems. Important concepts in the course include the structure and function of: communication systems, transport systems, the musculoskeletal system, the integumentary system, immune system, and metabolic processes. The central theme is how body systems work together to maintain homeostasis and good health. The systems are studied as “parts of a whole” that work together to keep the amazing human machine functioning at an optimal level. Students design experiments, investigate the structures and functions of body systems, and use data acquisition software to monitor selected body functions. Students work through interesting, real-world cases, and often play the role of biomedical professionals in solving medical mysteries. Students are expected to complete and present a mastery project each semester.

## **SOLAR SYSTEM ASTRONOMY**

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11th - 12th Grade

Credit - 1/2

One Semester

**Prerequisite: Physics and Chemistry, or departmental approval.**

This one-semester course for juniors and seniors explores the historical foundations and techniques of astronomy and pursues diverse investigations into the structure and function of our solar system. Topics include the development of methodologies for making and interpreting astronomical measurements, comparative planetology (structure, surfaces, & atmospheres), the evolution of our solar system over time, and our ongoing search for exoplanets (planets around other stars). We will also investigate the challenges of human space-travel, searching for alien life, and colonizing other moons and planets. This course meets one period per day with additional laboratory/field experiences planned outside of the regular school schedule. **(This course does not qualify for NCAA eligibility.)**

## **COSMOLOGY: Origins of the Universe**

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11th - 12th Grade

Credit - 1/2

One Semester

**Prerequisite: Biology, concurrent enrollment in Biology, or departmental approval**

This one-semester course for juniors and seniors provides an introduction to the physical processes in stars and the evolution of stars that leads to their observed properties. It includes a study of the final endpoints of stellar evolution and an introduction to the properties of galaxies and star formation in galaxies. Topics include the electromagnetic spectrum, classification, structure, and evolution of stars, the sun, galaxies, and the larger universe, including cosmology. We will also investigate challenges to understanding interstellar space and distant star systems by exploring a variety of research methodologies including the search for extraterrestrial intelligence and the potential for developing probes and other spacecraft capable of reaching other stars and galaxies. **(This course does not qualify for NCAA eligibility.)**

## **EVOLUTION**

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11th - 12th Grade

Credit - 1/2

One Semester

**Prerequisite: Biology, concurrent enrollment in Biology, or departmental approval.**

Evolution explores the nature of change on universal, planetary, and population levels. The broad theme of the class is that the laws of nature have shaped the development of the cosmos, our planet, and the organisms that inhabit it. To this end, we will develop an evidence-based understanding of the Big Bang, formation of our solar system, geological processes of the Earth, relative and absolute dating, the fossil record, plate tectonics, abiogenesis, population genetics, and cladistics. Students will also gain insight about the life history of Earth as we explore the succession of flora and fauna during the Paleozoic, Mesozoic, and Cenozoic eras.

## **FORENSIC SCIENCE**

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11th - 12th Grade

Credit - 1/2

One Semester

Forensic science is the application of science to legal situations. Students will formulate and critically examine problems, and investigate probable solutions. They will collect and scientifically evaluate data, draw conclusions based on evidence, apply data to authentic situations, and communicate the results of the work. The topics used to teach these skills include: crime scene investigation and photography, print exposure and analysis, trace evidence (the examination of hair, fiber, and fracture patterns in glass), serology (determining if blood is present, blood typing, microscopic identification of blood, and spatter pattern analysis), and forensic anthropology (the examination of skeletal remains to determine, age, sex, race, and height of the victim). This course gives students the opportunity to apply the concepts and skills learned in physics, chemistry, and biology to the real-life problems of crime scene investigation. **(This course does not qualify for NCAA eligibility.)**

## **ADVANCED FORENSIC SCIENCE**

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11th - 12th Grade

Credit - 1/2

One Semester

### **Prerequisite: Forensic Science**

Students in Advanced Forensic Science will process more complicated evidence than in the first level course. When studying arson, students will learn how to determine if a fire was accidental or intentional, what type of accelerant was used, and how to identify common motives of arsonists. When exploring toxicology, students will learn about the effects of drugs, poisons, and alcohol on the body. We address the nature of DNA, perform gel electrophoresis, and explore how it is used in our legal system. Students will also learn about geographical and behavioral profiling, eyewitness testimony and polygraphs as they study the criminal mind in forensic psychology. The cases we solve are complex and involve subtle clues with many twists. In our final project, facial reconstruction, students use tissue depth markers and clay to create a face from a skull. **(This course does not qualify for NCAA eligibility.)**

## **PHYSICS**

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11th - 12th Grade

Credit - 1

Full Year

### **Prerequisite: Chemistry and Biology or departmental approval; facility with Algebra and Trigonometry**

This course is designed as an introduction to the study of physics. It is appropriate for students who have never studied physics. It is also intended for students who have completed Freshman Physics and would like to extend their study of physics to include a broader range of topics with slightly greater emphasis on mathematical problem solving. The fundamental concepts of physics are emphasized with topics chosen from among the following: mechanics, wave motion, light, electricity, and magnetism. The course is laboratory-based as students will build physics concepts through laboratory investigations. Students will be expected to gather and interpret data, analyze experimental results and draw conclusions. Emphasis will be placed on the graphical analysis of experimental data. Experimental results will be documented in laboratory reports and organized as a laboratory portfolio. A scientific calculator capable of performing scientific notations and trigonometric functions is required. Although this course is taught at an introductory level, it is an excellent follow-up to Freshman Physics and includes many new topics and previously encountered topics in greater depth.

## **PLANT SCIENCE**

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11th – 12th Grade

Credit –1/2

One Semester

### **Prerequisite: Biology, Concurrent Enrollment in Biology or departmental approval.**

The mission of this class is to cultivate a love of plants that becomes a life-long passion to protect and conserve plants in a way that is infectious and benefits our world. Topics will include plant diversity, evolutionary relationships, germination, photosynthesis, growth, cells, tissues, organs, plant anatomy/physiology, reproduction, and propagation. The course will build to explore plant-based societal issues of conservation, climate change, food security, and genetically modified crops.

## **SCIENCE CAREER SEMINAR**

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11th - 12th Grade

Credit - 1/4

One Semester

**Prerequisite: Biology, Concurrent Enrollment in Biology or departmental approval.**

Designed for students who wish to explore careers in science, this semester course will meet two times per week and will focus on interaction with professionals working in various scientific fields. Students interested in obtaining firsthand information about life as a scientist, potential networking opportunities, and career options in science should consider enrolling. **(This course does not qualify for NCAA eligibility.)**