THE SCIENCE CURRICULUM 2013-2014

The Science department offers a variety of science experiences. Younger students are introduced to the richness and excitement of understanding the natural world. The curriculum is designed to be relevant to students' lives, and also to provide the foundation for further study of the more theoretical and abstract concepts of biological and physical phenomena.

Laboratory work is an integral part of every science course. Students learn in the early grades to observe carefully, collect accurate data, and draw scientific conclusions. Students in the introductory high school sciences and the Advanced Placement sciences work in the laboratory two double periods per week, and also attend three lectures or discussions per week. Those taking an Independent Study work individually with a science teacher-mentor to study a topic of interest through in-depth experimentation and research.

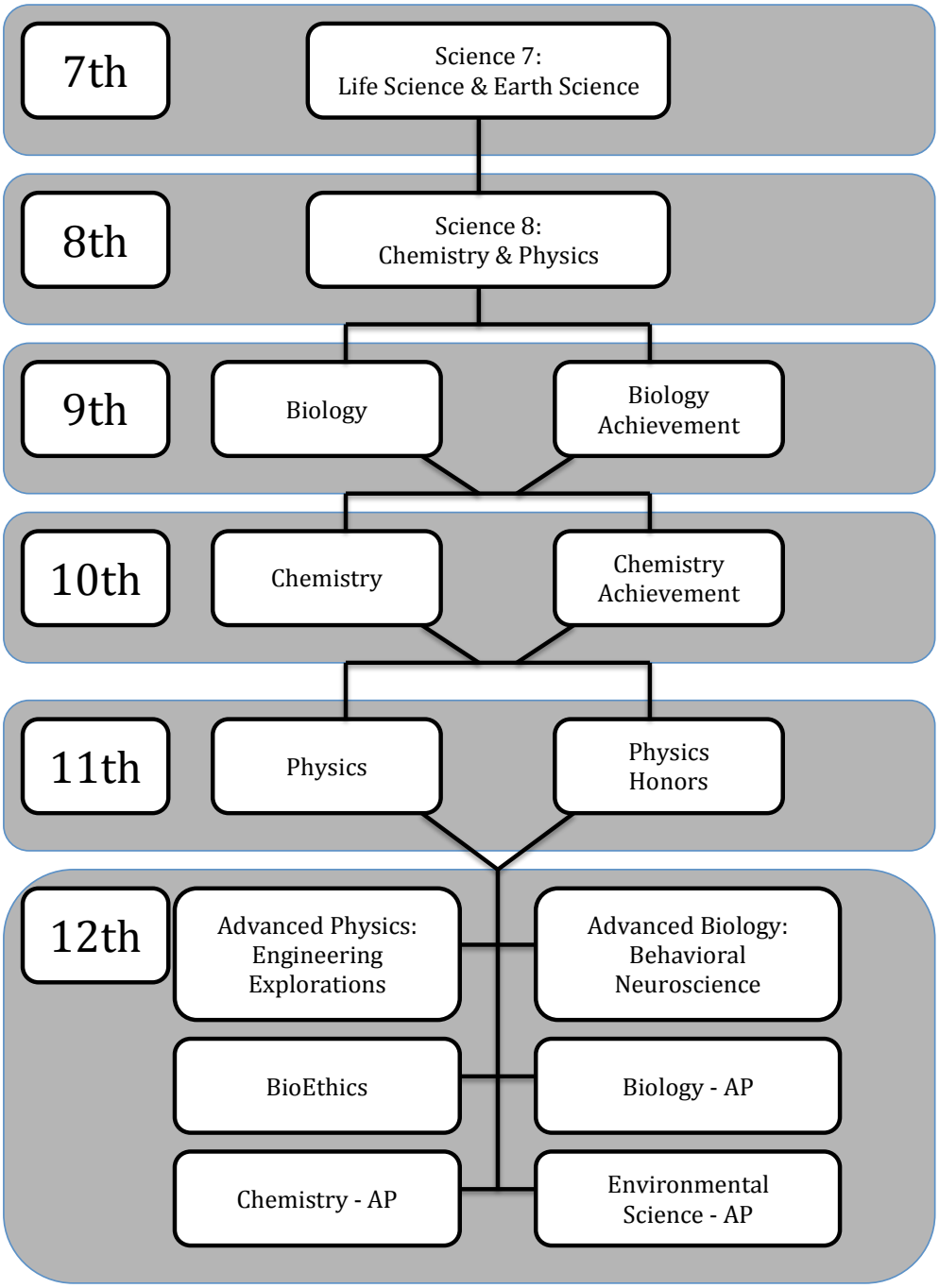
The sequence of courses in grades nine through twelve ensures that all students are presented the fundamentals of biology, chemistry and physics in their first three years of high school.

Students may write the SAT Subject test in Biology during their freshman year, and/or after Chemistry during their sophomore year, and/or after Physics during their junior year. In addition, students may elect to write the Advanced Placement Physics-B examination in their junior year following Physics-Honors. For their senior year, students may elect an Advanced Placement (college level) science or a course on a topic of interest.

> ***NOTE: The number of AP sections scheduled for juniors and seniors is determined by the number of sections that must be scheduled for regular courses and by AP enrollment projections. If actual enrollment exceeds class capacity, students asking for a specific AP course are chosen on the basis of their cumulative grade point average in Biology, Chemistry and Physics. Preference in this case is given to those who have shown the highest achievement in the strongest sequence of high school science courses.***

On the following page a flow chart demonstrates the typical sequences of science courses:

Typical Science Course Sequences



Exceptions to this flow chart are possible.

Lower School Science Courses

Science 7: Principles of Life Science and Earth Science
(Required; 4 periods/week, full year)

Understanding and working with scientific exploration is central to the study of all sciences. Thus students in both the Life Science semester and the Earth Science semester participate in a mixture of observational, directed, and inquiry-based laboratory activities and experiments. Students generate testable questions, work with and design controlled experiments, take measurements, organize data, draw conclusions, and present results in written and oral formats. The development of science and study skills such as outlining, note taking, keeping a class notebook, data graphing, and analyzing graphs are given particular attention throughout the year. Life Science includes topics on features of living things, cell structure and function, evolution and classification, and the animal kingdom while the Earth Science semester studies earth structure, rocks and minerals, and plate tectonics.

Science 8: Principles of Chemistry and Physics
(Required; 4 periods/week, full year)

Chemistry and Physics are each studied for one semester. Chemistry includes topics on classification of matter, the model of the atom, chemical reactions, and an introduction to acids and bases. Particle models of the states of matter and simple chemical reactions are utilized. Physics studies the motion of bodies, forces and interactions, and the energy involved with physical systems. Laboratory report-writing, observational skills, organizational skills, concept mapping, and study skills are emphasized throughout the semesters. Oral presentations emphasize cooperation with peers.

Upper School Science Courses

Biology
(Grade 9; 6 periods/week, full year; 1 unit)

This course provides a comprehensive overview of the central concepts of biology: cell structure and processes, genetics, human physiology, evolution, ecology and the diversity of life. Each week three periods are spent in the laboratory, carrying out experiments and investigations to enhance understanding and application of biological concepts. The remaining three are devoted to lectures and activities that include: computer labs, presentations, data analysis, cooperative learning, simulations, modeling, and discussions. Students are also required to participate in team projects and group explorations that involve using scientific method skills and writing formal lab reports. The course culminates in the spring with a four day trip to Drey Land for a field ecology study.

Biology Achievement
(Grade 9; 7 periods/week, full year; 1 unit)

This course covers the similar general topics as Biology but examines each area at a greater level of depth and detail, and proceeds at a faster pace. It provides a comprehensive overview of the central concepts of biology including cell structure and function, DNA and genetics, human and plant physiology, evolution, ecology and the diversity of life. Each week four periods are spent in the laboratory, carrying out experiments and investigations using the scientific method, while the remaining three are devoted to the

exploration and discussion of new material. The ecology unit culminates in the spring with a four-day trip to Drey Land for a field ecology study. Biology Achievement is the appropriate course for students with strong math and reading abilities who already have well developed study habits and organizational skills. At the end of the course, students will actively prepare for the Biology SAT Subject test in biology.

Chemistry
(Grade 10; Prerequisite Biology; 6 periods/week, full year; 1 unit)

This course introduces students to the study of our physical world at the atomic level through an active experimental approach. The classic essential topics of atomic structure, reactions and equations, chemical calculations and the mole, gas laws, periodicity, and acid-base chemistry are covered as well as recent topics related to chemistry's role in protecting and sustaining the environment. Problem solving is a major component of chemistry as well as laboratory investigations, lectures, demonstrations and reading assignments. Students make use of technology as a tool for analyzing data through graphing programs and take advantage of multiple web-based learning activities. Students are expected to have experience with both word processing and computer graphing programs. This course meets the needs of any student desiring a general background in chemistry.

Chemistry (Achievement)
(Grade 10; Prerequisite: Biology; 7 periods/week, full year; 1 unit)

This course is appropriate for students with strong study skills, for future science majors and for those considering taking the Chemistry SAT subject test. The work for the year is organized around key concepts and principles, which are preparatory for future science courses. These fundamental principles are often developed on the basis of experimental data and quantitative reasoning in the laboratory. Some experiments utilize computer based data collection technology while others use more traditional methods for collection. Lectures, demonstrations, reading assignments, and problem sessions emphasize the chemical bond, quantum model of the atom, periodicity of the elements, thermodynamics, nuclear chemistry, acids-bases, gas laws, oxidation-reduction reactions, stoichiometrics, and the mole concept. Animations, tutorials and simulations serve to enrich and clarify ideas. This course examines more topics, requires a deeper understanding of chemical concepts, relies heavily on mathematical explanations, and proceeds at a faster pace than Chemistry.

> **NOTE:** The Science Department recommends the following for students who are considering Chemistry (Achievement): Students should have completed Geometry 9 with at least two B's for trimester grades, including at least a B for the final trimester. An Algebra I(9) student should have at least two A-'s for trimester grades including at least an A- for the final trimester.

Physics
(Grade 11; Prerequisite: Chemistry and Algebra II (or concurrent registration);
7 periods/week, full year; 1 unit)

This course in physics includes the study of motion, forces, energy, momentum, waves, sound, light, and electricity. Students use a wide variety of graphical and pictorial tools, in addition to mathematics, to describe, to interpret, and to make predictions about physical phenomena. The curriculum is built upon a small number of essential physics concepts which are developed in depth and with conceptual coherency. Special projects give students opportunities to analyze complex situations and develop critical thinking skills.

Physics-Honors
(Grade 11; Prerequisites: Algebra II, Chemistry, and approval of Dept. Chair; 7 periods/week, full year; 1 unit, Honors credit)

This first year course in physics covers motion, forces, energy, momentum, waves, sound, light, electricity, magnetism, and atomic structure. This course employs a rigorous text and has a stronger emphasis on mathematical analysis than the regular Physics course, including a greater degree of difficulty in the problems and a greater use of trigonometry. The course includes extra and/or expanded coverage of topics, and the curriculum covers approximately 85% - 90% of the Physics B syllabus for the Advanced Placement examination.

> **NOTE:** The Science Department recommends the following for students who are considering Physics-Honors: Students should have completed Algebra II with at least two B's for trimester grades, including at least a B for the final trimester. A Chemistry (Achievement) student should have at least two B's for trimester grades including at least a B for the final trimester, and a Chemistry student should have at least two B+'s for trimester grades, including at least a B+ for the final trimester.

Independent Study-Science
(Grades 9-12; Prerequisites: approval by the teacher, department head, and principal; minimum of 2 periods/week; 1/3 credit)

Independent study on a scientific topic of interest to the student may be explored under direct supervision of a teacher in the department. A general idea or area of interest must be discussed with the supervising teacher before approval can be granted, and the student must be self-disciplined and committed to working on the project. The student must complete the Independent Study Contract during the first week of the semester in which the work begins. Independent study focuses on areas of science not taught in other available science courses.

NOTE: Preference is given to students who have taken biology, chemistry and physics prior to selecting AP or "Advanced" courses. None of the courses designated below as "Advanced" is intended as preparation for the Advanced Placement examinations.

*Advanced Physics: Engineering Explorations
(Grades 11 - 12; Prerequisites: Biology, Chemistry, Physics (or concurrent registration); 5 periods/week; full year; 1 unit)

In this project-based course students will be introduced to engineering, where the principles of science, mathematics and technology are applied to solve problems and create opportunities. Individual and team hands-on-projects will come from traditional engineering disciplines such as civil, electrical, biomedical, mechanical, structural, and materials science. Teacher guided activities and problems will prepare students to apply learned engineering concepts to real problems such as designing, building and testing a propeller system for a wind powered generator, a water purification system, or a resonance frequency tuner for a transmitting antenna. Guest engineers will speak to students about their special disciplines and may serve as mentors for designs. Student progress is evaluated with problem sets, tests on concepts, writing proposals and making presentations, and discussions of engineering ethics as well as project design and development, construction, and teamwork.

*Advanced Biology: Behavioral Neuroscience
(Grade 12; Prerequisites: Biology and Chemistry; 5 periods per week; full year; 1 unit)

This course examines the relationship between both human and animal behavior and the nervous system. The course begins by exploring evolutionary processes, the basic physiology of the neuron, the brain, and the endocrine system. This introduction is followed by investigations of human and non-human behavior from both an evolutionary and a nervous system perspective. Topics include sensation and perception, the biological mechanisms of drug action, learning and memory, evolutionary adaptations of behavior, sexual behavior, motivation and emotion, social behavior, and behavior disorders. Students spend one double period per week in the laboratory performing neurophysiology experiments, exploring neuroanatomy, performing experiments in animal behavior (such as conditioning rats and evaluating habitat preferences in select animals); and observing animal behavior at the zoo. During the second semester, students must devote portions of two or more free periods per week to rat training.

*Biology-AP
(Grades 11-12; Prerequisites: Biology, Chemistry; 7 periods/week, full year; 1 unit, Honors credit)

This course is designed to be the equivalent of a college introductory biology course usually taken by biology majors during their freshman year. The two main goals are to develop a conceptual framework for modern biology and to gain experience and practice of biology through experimentation and inquiry. The content explores and weaves together the four big ideas of biology: (1) Evolution drives the diversity and unity of life; (2) Organisms utilize energy and molecular building blocks; (3) Organisms retrieve, transmit and respond to information; and (4) Biological systems interact and these interactions create complex properties. By questioning, hypothesizing, observing, performing experiments, graphing and statistically analyzing data, and drawing logical conclusions during two double-period laboratories per week, students will develop and refine testable explanations and predictions of natural phenomena. Students enrolled in the course are expected to achieve at a level sufficient to earn college credit. Students are required to write the Advanced Placement examination in May (see p. 9, section 9 NOTE).

*Chemistry-AP
(Grade 12; Prerequisites: Chemistry-AP teacher approval, Chemistry (preferably Achievement), Physics, Pre-calculus); 7 periods/week, full year; 1 unit, Honors credit)

This course meets the objectives of a freshman chemistry course on the college level. The emphasis is on the mathematical and theoretical aspects of inorganic and organic chemistry and on training in fundamentals needed for future work in chemistry or in related fields. This course differs from the usual secondary school course in the kind of textbook used, the amount and kind of laboratory work, the emphasis on mathematical formulation of principles, and in the special consideration given to the arithmetical solutions of problems. Laboratory work includes college first-year experiments in inorganic chemistry plus extended independent studies in qualitative analysis and complex synthesis. This course follows the recommended program for chemistry published by the College Board. Students enrolled in the course are expected to achieve at a level sufficient to earn college credit, and thus are required to take the Advanced Placement examination in May (see p. 9, section 10 NOTE).

*Environmental Science -AP
(Grade 12; Prerequisites: Biology, Chemistry, Physics; 5 periods/week; full year; 1 unit; Honors credit)

AP Environmental Science is a college level integrated study of ecology and environmental science. The course provides students with the scientific principles, concepts, and methodologies required to understand the fundamental concepts of ecology; to identify, analyze, and evaluate environmental concerns both natural and human-made; and to examine possible solutions for resolving these environmental issues. Environmental science is an interdisciplinary study that draws from biological, physical, chemical, and earth sciences as well as social sciences including economics, politics, and sociology. One double period per week is devoted to laboratory and/or field investigations. The goal of these investigations is to complement the classroom portion of the course by allowing students to learn about the environment through firsthand observations and

experiments. Examples of investigations include: collecting and analyzing Deer Creek water and JBS bioretention soil samples, studies on local ecosystems, constructing and analyzing model windmills, and visiting local sites of environmental interest. Students enrolled in the course are required to take the Advanced Placement exam and are expected to achieve at a level sufficient to earn college credit. (see p. 9, section 10 NOTE).

*Bioethics (ONLY ONE SECTION OFFERED)
(Grade 12; 4 periods/week; full year; 1 unit)

This seminar explores the political and ethical decisions behind some recent and some historical scientific issues. Led by both a science and a history teacher, students explore the science behind the issues before confronting the political and ethical ramifications of them. Students are evaluated (written and orally) on their knowledge of the science and its political and ethical implications and are expected to be active participants in both segments of the class - the scientific component as well as the discussion component, which are weighted equally. Contemporary issues covered may include: gene therapy, cloning, medical marijuana, the genetics of race, HIV and AIDS, and the ethics of human and animal experimentation. Historical issues addressed may include: the use of research by Nazi scientists, the Tuskegee experiments, and the human radiation experiments. Students will choose their own topic for a group presentation in the spring. A sample approach follows: *if the topic was stem cells, students would learn what stems are, and what applications they might have, before considering ethical implications of such research, and whether or not the government should fund research into stem cells.*