WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

EXERCISE & SPORTS SCIENCE - 7451

School.....Westfield High School
Department ..... Science
Length of Course ..... One Year
Credit 6.0
Grade Level 10, 11, 12
Prerequisites ..... Biology and Chemistry
Date .....

I. RATIONALE, DESCRIPTION AND PURPOSE

Exercise and Sports Science is a laboratory science course that integrates biology, chemistry and physics concepts that relate to human movement. The objective of this course is to apply central science concepts to the study of sport and exercise. The fundamental principles of physics are used to analyze body movements and the interaction of the body with the ground and other objects. The physics principles needed are covered in the course content. Biology and chemistry concepts are used to explore the function of the human body systems and how their functions change during and after physical activity. Case studies and current events are used to highlight the relevance of course content, and to introduce ethical discussions.

With rising rates of obesity, diabetes, heart disease, and hypertension nationwide, the positive health impact of an active lifestyle cannot be understated. Furthermore, a large percentage of Westfield students participate in athletic programs within the high school, and are interested in careers in medicine, physical and occupational therapy, personal training, athletics, physical education, athletic training, and coaching. Such fields are based in the fundamental understanding of how the body moves, how it adapts to regular physical activity, and how human health is positively affected by an active lifestyle.

II. OBJECTIVES

The district objectives are aligned with the New Jersey Student Learning Standards for Science, the New Jersey Student Learning Standards for Mathematics, English Language Arts, Technology, and 21st Century Life and Careers. They are developed sequentially throughout the course.

Science Practices

Students:

A. Demonstrate proper lab technique and safety precautions when working with equipment in a laboratory setting
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3

B. Understand and differentiate between the interdependence of science and technology
New Jersey Student Learning Standards for Science: Science and Engineering Practices P6
New Jersey Student Learning Standards for Educational Technology 8.1.A

C. Demonstrate a knowledge, understanding and practical use of the library/media center resources as these relate to the course content
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Educational Technology 8.1.E
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.1
New Jersey Student Learning Standards for English Language Arts: Anchor Standards for Writing NJSLSA.W6

D. Utilize acute observation skills to formulate testable questions and hypotheses and then apply logic in interpreting their observations to design and conduct controlled experiments using various laboratory techniques
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1, P2, P3
New Jersey Student Learning Standards for Educational Technology 8.1.F
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.3

E. Collect qualitative and quantitative data, present it in table and graph form, analyze it and arrive at a conclusion that evaluates the data for sources of error and poses new hypotheses for communication and further study
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4, P6, P7, P8
New Jersey Student Learning Standards for Educational Technology 8.1.C
New Jersey Student Learning Standards for Mathematical Practice SMP4

F. Recognize that scientific knowledge is tentative and predictions or explanations can be revised as new evidence emerges and evaluate the strength of scientific arguments based on the quality of the data and evidence presented
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4, P7, P8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.8

G. Communicate with others to test new ideas, solicit and provide feedback, articulate and evaluate emerging explanations, develop shared representations and models, and reach consensus
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2, P7, P8
New Jersey Student Learning Standards for English Language Arts: Anchor Standards for Speaking and Listening: NJSLSA.SL1
New Jersey Student Learning Standards for English Language Arts: Anchor Standards for Language.NJSLSA.W2, NJSLSA.W6

H. Demonstrate proficiency in the use of laboratory technology including, but not limited to, data collection probeware, video analysis software and research microscopes.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3

Mechanics of Movement

Students:

A. Identify the anatomical planes in which body movements can occur, locate the axes of rotation of each joint, and identify the different movements that can occur
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2, P5

B. Analyze the forces and torques involved in body movements, and identify the muscles and bones involved in their production
New Jersey Student Learning Standards for Science HS-LS1-2, HS-PS2-1, HS-PS2-3

C. Construct a model of a human joint that accurately demonstrates the roles of the relevant muscles, cartilage, tendons, bones, and ligaments
New Jersey Student Learning Standards for Science HS-LS1-2, HS-PS3-3, HS-ETS1-4

D. Apply the principles of inertia, momentum and impulse to describe the movement of the brain during a concussion.
New Jersey Student Learning Standards for Science HS-PS2-1, HS-PS2-2, HS-PS2-3

Human Energetics & Metabolism

Students:

A. Compare and contrast the molecular structures and functions of carbohydrates, lipids and proteins, and their roles in providing energy at various exercise durations and intensities
New Jersey Student Learning Standards for Science HS-LS1-7

B. Analyze the energy transformations that occur within cells, and how those energy transformations produce both heat energy, as well as mechanical work for body movements that transfer energy to the ground and other objects
New Jersey Student Learning Standards for Science HS-PS1-4, HS-PS1-5, HS-LS1-7

C. Compare and contrast ATP production by aerobic respiration, glycolysis, and phosphocreatine system in terms of their substrates, the conditions under which they occur, ATP yield, and limiting factors.
New Jersey Student Learning Standards for Science HS-PS1-5, HS-PS1-6, HS-LS1-7

Human Anatomy & Physiology Applied to Exercise

Students:

A. Explain how muscle contraction is achieved by the interaction of cell components, proteins, ions, and ATP within a muscle cell
New Jersey Student Learning Standards for Science HS-LS1-2

B. Compare and contrast the structures, metabolic capabilities and power outputs of type I, type IIa, and type IIb muscle fibers, and identify the unique situations in which they would be recruited by the nervous system to perform work
New Jersey Student Learning Standards for Science HS-LS1-2, HS-LS1-7

C. Explain the interactions between the nervous and muscular systems in determining an athlete's strength, speed, flexibility, and coordination
New Jersey Student Learning Standards for Science HS-LS1-2

D. Explain how the events of an action potential within a motor neuron are initiated, transmitted to other neurons, and relayed to muscle fibers for contraction
New Jersey Student Learning Standards for Science HS-LS1-2

E. Evaluate the influences of the cardiovascular, respiratory, and biochemical systems on VO_{2MAX}, economy of movement, and lactate threshold to determine a person's endurance capability
New Jersey Student Learning Standards for Science HS-PS1-6, HS-LS1-2

F. Discuss the effects of performance enhancing drugs (PEDs), the methods employed to detect their use, and the limitations of drug testing in the field
New Jersey Student Learning Standards for Science HS-ETS1-4, HS-ESS3-3

G. Explain the unique considerations required for successful performance of female athletes
New Jersey Student Learning Standards for Science CCC2, CCC4

H. Identify the acute responses and chronic adaptations that occur with various modes of training at the system, organ, tissue, cellular, and biochemical levels
New Jersey Student Learning Standards for Science HS-LS1-2, HS-LS1-7

I. Evaluate the impact of sedentary lifestyle on the health of the skeletal, muscular, endocrine, cardiovascular, and biochemical systems
New Jersey Student Learning Standards for Science CCC2, CCC4

J. Explain the homeostatic role of the endocrine system in the regulation of organ, tissue and cellular functions at rest, and contrast the activity of the endocrine system at rest, during, and after exercise
New Jersey Student Learning Standards for Science HS-LS1-3, CCC4

K. Demonstrate understanding of the homeostatic functions of the brain, heart, blood, lungs, and kidneys during exercise.
New Jersey Student Learning Standards for Science HS-LS1-2, HS-LS1-3

Application of Physical, Biochemical, and Physiological Concepts

Students:

A. Explain the importance of macronutrients, vitamins, and minerals to the proper function of the body, and discuss dietary considerations for specific exercise programs
New Jersey Student Learning Standards for Science HS-LS1-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P6

B. Design a training program that meets a specific training goal in a particular sport
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2, P3, P4, P6

C. Evaluate symptoms of injured athletes and assess available treatment options.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2, P3, P4, P6

III. CONTENT, SCOPE, AND SEQUENCE

The course applies concepts from biology, chemistry, and physics to explain how the body generates movement, how the body adapts to the stresses of acute and chronic exercise, with nutritional and health considerations. Case studies may be used to highlight the relevance of course content to current events.

A. Anatomical Concepts (Suggested pacing: 3 weeks)
   1. Anatomical terminology – directions and planes
   2. Kinesiology – identification of body movements

B. Skeletal and Muscular Anatomy (Suggested pacing: 6 weeks)
   1. Functions of the skeletal and muscular systems
   2. Skeletal anatomy
      a. Types of bones
      b. Bone features
      c. Types of joints
      d. Connective tissues

3. Calcium homeostasis and feedback
    a. Osteoporosis
    b. Female Athlete Triad (FAT) /Relative Energy Deficiency (RED)
4. Sports Medicine
    a. Acute injuries
    b. Overuse injuries
    c. Nutritional deficiencies

C. Principles of Training (Suggested pacing: 2 weeks)
1. Five bio-motor abilities
2. Training
    a. General Adaptation Syndrome (GAS) – stress and recovery
    b. Principles of training
    c. Training variables: frequency, intensity, duration
    d. Overtraining and detraining
3. Components of a training session
    a. Warm-up
    b. Cool-down
    c. Delayed-Onset Muscle Soreness (DOMS)

D. Nutrition (Suggested pacing: 3 weeks)
1. Macronutrients – structure/function of carbohydrates, lipids, and proteins
2. Micronutrients – vitamins and minerals
3. Blood sugar homeostasis
    a. Glycemic index, glycemic load
    b. Endocrine regulation of blood sugar
    c. Diabetes mellitus
4. Nutrient loading and timing

E. Metabolism – ATP Production (Suggested pacing: 3 – 4 weeks)
1. Thermodynamics
2. Kinetics
3. ATP/ADP cycle – How cells perform work
4. ATP production (respiration)
    a. Anaerobic processes – creatine phosphate and glycolysis
    b. Aerobic process
5. Contributions of PC/Glycolysis/Aerobic pathways at various exercise durations and intensities
    a. Fuel utilization – epinephrine, norepinephrine, and cortisol
    b. Metabolic rate – TSH, T_3, and T_4
6. Training adaptations that improve ATP production

F. Cardiovascular System (Suggested pacing: 4 weeks)
1. Heart
    a. Anatomy
    b. Measuring heart function
        1) Cardiac output
        2) Stroke volume
        3) Ejection fraction

c. Electrical activity
    1) Electrical pathways
    2) EKG
2. Blood vessels
    a. Types of blood vessels
    b. Regulation of blood flow
        1) Heart rate
        2) Vasoconstriction and vasodilation
        3) Thermoregulation
    c. Blood pressure homeostasis
3. Blood
4. Components of blood
5. Regulation of RBC production
6. Training adaptations to cardiovascular system
7. Blood doping and Biological Passport
8. Exercise and cardiovascular health – heart disease, heart attack, stroke, hypertension

G. Pulmonary System (Suggested Pacing: 1 week)
1. Anatomy
2. Muscle contractions involved in ventilation
3. Pulmonary adaptations to endurance training
4. Respiratory Exchange Ratio (RER)

H. Biomechanics (Suggested Pacing: 4 weeks)
1. Translational and Rotational Movement
2. Active & passive Forces
3. Types of muscle contraction
4. Rotational Motion
    a. Torque
    b. Moment of Inertia
    c. Three classes of lever systems
5. Work, Power, and Energy
    a. Positive vs. negative work
    b. Elastic energy storage and passive force production

I. Nervous System & Neuromuscular Control of Movement (Suggested pacing: 2 – 3 weeks)
1. Anatomy of nerves and neurons
2. Signal transmission within and between neurons
3. Motor unit organization
4. Proprioception - muscle spindles & Golgi tendon organs
5. Neuromuscular development/Motor learning

J. Muscle Structure and Function (Suggested pacing: 2 weeks)
1. Muscle tissue types – smooth, skeletal, cardiac
2. Muscle fiber anatomy and physiology
3. Muscle fiber types – I, IIa, IIb
4. Hormonal regulation of muscle development: testosterone, cortisol

K. Strength Training (Suggested pacing: 2 weeks)
   1. Adaptations of bones, muscles, tendons, and nerves to resistance training
   2. Program design: exercise selection, sequence, frequency, volume, load, progression, and periodization

L. Fluid Balance & Kidney Function During Exercise (Suggested pacing: 2 weeks)
   1. Kidney anatomy
   2. Nephron structure and function
   3. Hormonal control of kidney – aldosterone and Antidiuretic Hormone (ADH)
   4. Changes to kidney function during exercise
   5. Dehydration, hyponatremia, and sports drinks
   6. Iowa Wrestling Studies and NJSIAA wrestling hydration rules.

IV. INSTRUCTIONAL TECHNIQUES

Differences in learning style, readiness and interest are addressed. Class discussions, written notes, laboratory activities, multimedia presentations, and various models address auditory, visual and kinesthetic preferences. The following techniques are used, but not limited to:

A. Classroom lecture and discussion
B. Socratic dialogue that requires analysis and synthesis of information from a variety of sources
C. Cooperative learning and small group instruction
D. Dissections
E. Kinesthetic activities to illustrate concepts when applicable
F. Laboratory activities, demonstrations, and experiments that require collection, organization, representation, and analysis of data
G. Visual models, animations, and video to illustrate or enhance class discussions
H. Critical reading of primary sources
I. Data acquisition probes for data collection and analysis
J. Multimedia presentations
K. Computer simulations
L. Guest speakers.

V. EVALUATION

Student performance will be evaluated by the following:

A. Individual and group reports/presentations of lab exercises and findings
B. Student participation, conduct, and adherence to safety rules
C. Scale models and visual aids
D. Baseline and benchmark assessments
E. Class work and participation as indicators of an appropriate level of understanding and the application of learning
F. Use of the library/media center and technology to complete projects and assignments.

VI. PROFESSIONAL DEVELOPMENT

Opportunities for professional development may include:

A. In-services, teacher conferences, and conventions
B. Access to professional books and journals
C. Work with other departments to coordinate activities
D. College courses
E. Discussions about homework, unit plans and assessment
F. Professional organizations
G. Confer with colleagues in the science department and interdepartmental areas to discuss and reflect upon unit plans, homework and assessment.

APPENDIX I

New Jersey Student Learning Standards for Science

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
HS-PS1-6. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.
HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*
HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

NGSS Appendix F – Science and Engineering Practices
P1 - Asking Questions and Defining Problems
P2 - Developing and Using Models
P3 - Planning and Carrying Out Investigations
P4 - Analyzing and Interpreting Data
P5 - Using Mathematics and Computational Thinking
P6 - Constructing Explanations and Designing Solutions
P7 - Engaging in Argument from Evidence
P8 - Obtaining, Evaluating, and Communicating Information

NGSS Appendix G – Cross Cutting Concepts
CCC1 - Patterns
CCC2 - Cause and effect: Mechanism and explanation
CCC3 - Scale, proportion, and quantity
CCC4 - Systems and system models
CCC5 - Energy and matter: Flows, cycles, and conservation
CCC6 - Structure and function
CCC7 - Stability and change

The entire standards document may be viewed at: http://www.state.nj.us/education/cccs/2016/science/
http://www.nextgenscience.org/next-generation-science-standards.

APPENDIX II

New Jersey Student Learning Standards for Educational Technology

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
8.1.A Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
8.1.C Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
8.1.E Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
8.1.F Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

The entire standards document may be viewed at: http://www.nj.gov/education/cccs/2014/tech/

APPENDIX III

New Jersey Student Learning Standards for English Language Arts

RH.11-12.1 Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
RH.11-12.3 Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
RH.11-12.8 Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
NJSLSA.SL1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NJSLSA.W2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.

The entire standards document may be viewed at http://www.nj.gov/education/cccs/2016/ela/

APPENDIX IV

New Jersey Student Learning Standards for Mathematical Practice

SMP4 – Model with mathematics.

The entire standards document may be viewed at http://www.state.nj.us/education/aps/cccs/math

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

FORENSIC SCIENCE - 7450

School.....Westfield High School
Department.....Science
Length of Course.....One Year
Credit.....6.0
Grade Level.....10, 11, 12
Prerequisites.....Biology and Chemistry
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

Forensic Science is a laboratory science course that integrates previously learned concepts in Biology and Chemistry courses to the field of science that analyzes legal issues. It is a multidisciplinary subject, drawing principally from chemistry and biology, but also integrating physics, geology, psychology, mathematics, and social science. Students learn how anyone employed in the field of forensics would greatly benefit from having a strong STEM background. During the course, students gain the knowledge necessary to solve complex, real-world problems.

The field of Forensic Science represents the combined inspired thinking and creativity of many scientific disciplines that have revolutionized criminal justice. Each significant development rests upon previous discoveries. The historical perspective and interdisciplinary nature of this field is stressed throughout the course. Forensic Science presents real-life applications of universal scientific principles that relate to all students, therefore all students are encouraged to envision themselves as career scientists.

Forensic Science uses a case-study approach, where students research actual criminal investigations. In addition, students have the opportunity to analyze mock crime scenes and prepare reports in which detailed accounts of technique and results are fully communicated. This method of authentic assessment allows students to develop critical thinking and creative, problem-solving skills. Students gain an understanding of how forensic experts use science in real-life scenarios. Forensics Science makes the study of STEM fields more relevant in students' lives.

II. OBJECTIVES

The district objectives are aligned with the New Jersey Student Learning Standards for Science, the New Jersey Student Learning Standards for Mathematics, English Language Arts, Technology, and 21st Century Life and Careers. They are developed sequentially throughout the course.

Students:

A. Demonstrate proper lab technique and safety precautions when working with equipment in a laboratory setting
New Jersey Student Learning Standards for Science: HS-ETS1-2
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3

B. Understand and differentiate between the interdependence of science and technology
New Jersey Student Learning Standards for Science: Science and Engineering Practices P6
New Jersey Student Learning Standards for Educational Technology 8.1.A

C. Demonstrate a knowledge, understanding and practical use of the library/media center resources as these relate to the course content
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Educational Technology 8.1.E
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.1
New Jersey Student Learning Standards for English Language Arts: Anchor Standards for Writing NJSLSA.W6

D. Utilize acute observation skills to formulate testable questions and hypotheses and then apply logic in interpreting their observations to design and conduct controlled experiments using various laboratory techniques
New Jersey Student Learning Standards for Science: HS-ETS1-2, HS-PS1-3, HS-PS3-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1, P2, P3
New Jersey Student Learning Standards for Educational Technology 8.1.F
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.3

E. Collect qualitative and quantitative data, present it in table and graph form, analyze it and arrive at a conclusion that evaluates the data for sources of error and poses new hypotheses for communication and further study
New Jersey Student Learning Standards for Science: HS-PS1-7, HS-PS2-1
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4, P6, P7, P8
New Jersey Student Learning Standards for Educational Technology 8.1.C
New Jersey Student Learning Standards for Mathematical Practice SMP4

F. Recognize that scientific knowledge is tentative and predictions or explanations can be revised as new evidence emerges and evaluate the strength of scientific arguments based on the quality of the data and evidence presented
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4, P7, P8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.8

G. Communicate with others to test new ideas, solicit and provide feedback, articulate and evaluate emerging explanations, develop shared representations and models, and reach consensus
New Jersey Student Learning Standards for Science: HS-LS1-2, HS-LS1-4, HS-PS1-1, HS-PS1-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2, P7, P8
New Jersey Student Learning Standards for English Language Arts: Anchor Standards for Speaking and Listening: NJSLSA.SL1
New Jersey Student Learning Standards for English Language Arts: Anchor Standards for Language.NJSLSA.W2, NJSLSA.W6

H. Interpret a technical journal article
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.1-2, 4-6, 8-10
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects WHST.11-12.7-9
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8

I. Compare the reliability of eyewitness testimony to actual events
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4

J. Summarize and apply the steps of a crime-scene investigation
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects WHST.11-12.8
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1, P2, P3, P4
New Jersey Student Learning Standards for Science HS ETS1-2

K. Evaluate different types of evidence (i.e. direct/testimonial, indirect/circumstantial, trace, individual, class)
New Jersey Student Learning Standards for Science: HS-LS1-1, HS-LS3-1, HS-LS3-3, HS-PS1-2, HS-PS1-5
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4

L. Present crime scene results in both written and oral formats and defend conclusions.
New Jersey Student Learning Standards for Science: HS-LS3-3
New Jersey Student Learning Standards for Educational Technology 8.1.C
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.4,
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects WHST.11-12.8, 9
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8

III. CONTENT, SCOPE, AND SEQUENCE

The content and scope of Forensic Science requires the application of theoretical, scientific, and mathematical concepts to solve criminal investigations. It is a multidisciplinary subject, drawing principally from chemistry and biology, but also integrating physics, geology, psychology, mathematics, and social science. Forensic Science emphasizes an inductive approach to the development of concepts. It is a traditional college-preparatory course that prepares students for further studies in the sciences.

The scientific concepts included in this course are interconnected, rather than sequential. For this reason, there are many valid sequences for organizing the content of this course to unify scientific concepts.

A. Unit 1: Introduction to Forensic Science (suggested pacing: 2-3 weeks)
1. History of forensic science
2. Types of crime labs: i.e. biology, chemistry, toxicology, ballistics, trace evidence
3. Career options available
4. Lab skills and safety

B. Unit 2: Crime Scene Investigation (suggested pacing: 3 weeks)
1. Observation skills versus inference: eyewitness testimony
2. Locard's exchange principle
3. Types of evidence: i.e. direct/testimonial, indirect/circumstantial, trace, class, individual
4. Crime scene investigation steps: securing the scene, searching for evidence, collecting evidence
5. Documentation and presentation skills

C. Unit 3: Questioned Document Analysis & Cybercrime (suggested pacing: 2-3 weeks)
1. Handwriting characteristics based on letter form, line form, and formatting
2. Hardware analysis: i.e. ink, paper
3. Forgery and fraudulence: i.e. counterfeit checks, paper currency, literary works, art
4. Cybercrime: common types, how analysts collect evidence and protect against it

D. Unit 4: Suspect Identification / Fingerprinting (suggested pacing: 2-3 weeks)
   1. Fingerprint patterns: i.e. arch, whorl, loop
   2. Fingerprint types: i.e. patent, plastic, and latent
   3. Fingerprint visualization and collection
   4. Forensic psychology: i.e. criminal profiling, deception detection, expert witness role

E. Unit 5: Forensic Impressions (suggested pacing: 3 weeks)
   1. Type of impressions: patent, latent, and plastic
   2. Techniques for lifting impressions and analyzing them
   3. Tool marks: indentation, abrasion, cutting

F. Unit 6: Ballistics / Glass (suggested pacing: 3 weeks)
   1. Types of weapons and ammunition
   2. Gunshot residue
   3. Bullet trajectory
   4. Glass structure and properties (density, refractive index)
   5. Fracture patterns in broken glass

G. Unit 7: Blood Analysis (suggested pacing: 3 weeks)
   1. Cellular composition: i.e. erythrocytes, leukocytes, platelets, antibodies
   2. Blood types and probability within a population
   3. Blood spatter analysis: shape, size, point of origin, directionality

H. Unit 8: Death Investigation (suggested pacing: 2-3 weeks)
   1. Coroner versus medical examiner
   2. Autopsy: i.e. how is it done; determining cause, manner, & mechanism of death
   3. Body changes upon death: i.e. livor mortis, rigor mortis, algor mortis
   4. Forensic entomology

I. Unit 9: Forensic Anthropology (suggested pacing: 2-3 weeks)
   1. Bone development
   2. Osteobiography: sex, age, height, race

J. Unit 10: Trace Evidence - Hair & Fiber (suggested pacing: 2 weeks)
   1. Hair structure: medulla, cortex, and cuticle
   2. Human versus nonhuman hair
   3. Medullary index
   4. Textile weave patterns
   5. Natural and synthetic fiber characteristics and classifications
   6. Burn analysis of fibers

K. Unit 11: Trace Evidence - Pollen & Soil (suggested pacing: 3 weeks)
   1. Pollen and spore characteristics
   2. Forensic palynology
   3. Soil type and composition
   4. Soil analysis: color, shape, size, odor, PH

L. Unit 12: Toxicology & DNA Analysis (suggested pacing: 3-4 weeks)
   1. Controlled substances (hallucinogens, narcotics, stimulants, anabolic steroids, depressants) and toxins (alcohol, bacterial, heavy metals, pesticides) and their effects
   2. Urinalysis and drug identification using chemical reagents
   3. DNA organization: i.e. chromosomes, genes, alleles, DNA nucleotides
   4. Genetic profiling: i.e. DNA extraction, gel electrophoresis, RFLP, SNP

IV. INSTRUCTIONAL TECHNIQUES

Differences in learning style, readiness and interest are addressed. Class discussions, written notes, laboratory activities, multimedia presentations, and various models address auditory, visual and kinesthetic preferences. The following techniques are used, but not limited to:

A. Classroom lecture and discussion
B. Cooperative learning and small group instruction
C. Problem-based learning activities
D. Electronic presentations - both student and teacher generated
E. Classroom demonstrations
F. Laboratory activities, demonstrations, and experiments that require collection, organization, representation, and analysis of data
G. Visual models, animations, and video to illustrate or enhance class discussions
H. Critical reading of primary sources
I. Multimedia presentations
J. Computer simulations
K. Field trips
L. Expert guest speakers.

V. EVALUATION

Student performance will be evaluated by the following:

A. Class work and participation as indicators of an appropriate level of understanding and the application of learning
B. Written reports and presentations that analyze case studies to demonstrate evidence observation, collection, and analysis
C. Student laboratory performance, conduct, and adherence to safety rules
D. Baseline and benchmark assessments
E. Class work and participation as indicators of an appropriate level of understanding and the application of learning
F. Use of the library/media center and technology to complete projects and assignments.

VI. PROFESSIONAL DEVELOPMENT

Opportunities for professional development may include:

A. In-services, teacher conferences, and conventions
B. Access to professional books and journals
C. Work with other departments to coordinate activities
D. College courses
E. Discussions about homework, unit plans and assessment
F. Professional organizations
G. Confer with colleagues in the science department and interdepartmental areas to discuss and reflect upon unit plans, homework and assessment.

APPENDIX I

New Jersey Student Learning Standards for Science

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-4. Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS3-1. Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
HS-LS3-3. Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
HS-PS1-5. Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
HS-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

NGSS Appendix F – Science and Engineering Practices
P1 - Asking Questions and Defining Problems
P2 - Developing and Using Models
P3 - Planning and Carrying Out Investigations
P4 - Analyzing and Interpreting Data
P5 - Using Mathematics and Computational Thinking
P6 - Constructing Explanations and Designing Solutions
P7 - Engaging in Argument from Evidence

P8 - Obtaining, Evaluating, and Communicating Information

NGSS Appendix G – Cross Cutting Concepts
CCC1 - Patterns
CCC2 - Cause and effect: Mechanism and explanation
CCC3 - Scale, proportion, and quantity
CCC4 - Systems and system models
CCC5 - Energy and matter: Flows, cycles, and conservation
CCC6 - Structure and function
CCC7 - Stability and change

The entire standards document may be viewed at: http://www.state.nj.us/education/cccs/2016/science/ http://www.nextgenscience.org/next-generation-science-standards.

APPENDIX II

New Jersey Student Learning Standards for Educational Technology

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
8.1.A Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
8.1.C Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
8.1.E Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
8.1.F Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

The entire standards document may be viewed at: http://www.nj.gov/education/cccs/2014/tech/

APPENDIX III

New Jersey Student Learning Standards for English Language Arts

RH.11-12.1 Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
RH.11-12.3 Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
RH.11-12.8 Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
RST.11-12.1 Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

RST.11-12.2 Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
RST.11-12.10 By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.
NJSLSA.SL1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
NJSLSA.W2 Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W6 Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.
WHST.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
WHST.11-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

The entire standards document may be viewed at http://www.nj.gov/education/cccs/2016/ela/

APPENDIX IV

New Jersey Student Learning Standards for Mathematical Practice

SMP4 – Model with mathematics.

The entire standards document may be viewed at http://www.state.nj.us/education/aps/cccs/math