Attachment #2
February 25, 2020

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

CHEMISTRY II AP – 7154

School.....Westfield High School
Department.....Science
Length of Course.....One Year
Credit.....6.0
Grade Level.....10, 11, 12
Prerequisite .....Chemistry I
Pre/Co-requisite ..... Physics I or AP Physics 1
Date.....

I. RATIONALE, DESCRIPTION AND PURPOSE

Chemistry II AP is aligned with the AP Chemistry framework as defined by the College Board. The content of the course is organized into four "big ideas" which are Quantities in Chemistry, Structure and Properties, Transformations, and Energy. The framework emphasizes instruction that promotes enduring, conceptual understandings. By de-emphasizing factual recall, the framework allows more time for inquiry-based learning of essential concepts and helps students develop the reasoning skills necessary to engage in science practices. Advanced inquiry and reasoning skills are used for science practices such as designing a plan for collecting data, analyzing data, applying mathematical routines, and connecting concepts in and across domains. These science practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena.

Chemistry II AP is designed to be the equivalent of the general chemistry course usually taken during the first year of college. Successful students of Chemistry II AP will be ready to study advanced chemistry topics in subsequent college courses. Students who achieve a satisfactory score on the Advanced Placement Examination in Chemistry may receive advanced placement and advanced credit in chemistry. Such students may thereby opt to begin their college or university studies with higher-level chemistry courses, permitting them to achieve more during their college careers.

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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2

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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP11

C. 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 P1,2,3
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.3
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,6,8

D. 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 P4,6,7,8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.4
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,8

E. 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 P4,7,8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.8
New Jersey Student Learning Standards for Mathematical Practice SMP8

F. 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 P2,7,8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects WHST.11-12.1, 11-12.8
New Jersey Student Learning Standards for 21st Century Life and Careers CRP4,8
New Jersey Student Learning Standards for Mathematical Practice SMP3

G. Demonstrate proficiency in the use of laboratory technology including, but not limited to, data collection probe ware, and video analysis software and research microscopes.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.9
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,11

Chemistry Practices:

Students:

A. Analyze experimental data and apply stoichiometric concepts to determine chemical formulas and masses of reactants/products in chemical reactions
New Jersey Student Learning Standards for Science: HS-PS1-7
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1,2,4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

B. Predict the products of simple reactions, write net ionic equations, and classify reactions by type
New Jersey Student Learning Standards for Science: HS-PS1-2
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P3,4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP2,4,8,11

C. Evaluate various gaseous systems to determine the quantitative relationships between pressure, temperature and moles of molecules, and explain these relationships by applying the kinetic molecular theory
New Jersey Student Learning Standards for Science: HS-PS1-7
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1,2,4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP2,4,8,11

D. Analyze data from calorimetry experiments to determine the energy changes of various chemical and physical changes and explain energy transfer by using concepts of bond energies
New Jersey Student Learning Standards for Science: HS-PS1-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1.2.4.5.6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

E. Justify the accepted quantum mechanical model of electronic structure by analyzing photoelectron and emission spectroscopic data; apply concepts of electronic structure to explain and predict periodic trends, reactivity and properties of elements
New Jersey Student Learning Standards for Science: HS-PS1-1, HS-PS1-2, HS-PS4-1, HS-PS4-3
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1,2,4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

F. Predict and explain physical and chemical properties of substances by applying concepts of molecular structure and strengths of attractions
New Jersey Student Learning Standards for Science: HS-PS1-3
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

G. Quantify how changes in concentrations, temperature, surface area, and the use of a catalyst affect the rate of a reaction and explain changes using collision theory
New Jersey Student Learning Standards for Science: HS-PS1-5
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1,2,4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

H. Analyze various equilibrium systems and predict the shifts in equilibrium when external stresses are applied
New Jersey Student Learning Standards for Science: HS-PS1-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1,2,4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

I. Evaluate the thermodynamic favorability of reactions using concepts of enthalpy and entropy, making sure to understand the relationship between spontaneity and equilibrium
New Jersey Student Learning Standards for Science: HS-PS1-4, HS-PS1-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1.2.4.5.6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

J. Predict properties of electrochemical cells by applying concepts of half-reactions, electric reduction potentials, Faraday's laws and concentration effects.
New Jersey Student Learning Standards for Science: HS-PS1-1, HS-PS1-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices: P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP 1,2,4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st-Century Life and Careers: CRP 2,4,8,11

III. CONTENT, SCOPE AND SEQUENCE

The four "big ideas" of the course are Quantities in Chemistry, Structure and Properties, Transformations and Energy. Extensive laboratory experiences are fully integrated into the course. Advanced reasoning and inquiry are emphasized.

A. Matter and Measurement
1. Units of measurement
2. Dimensional analysis (unit one conversions or factor label method)
3. Representation of uncertainty using significant digits
4. Physical methods of purification and identification of substances
5. Atomic theory and the structure of the atom
6. Average atomic mass and isotopes
7. Nomenclature of ionic and molecular compounds

B. Chemical Formulas and Equations
   1. Molar masses of elements and compounds
   2. The mole as a quantity unit
   3. Percent composition, empirical formulas and molecular formulas
   4. Experimental determination of empirical formulas (combustion analysis)
   5. Chemical equations and balancing chemical equations – the conservation of mass
   6. Stoichiometric calculations using the mole concept (includes limiting reactant problems)
   7. Calculations of theoretical product yields

C. Reactions in Aqueous Solutions
   1. Electrolytic properties of solutions
   2. Types of reactions (precipitation, replacement, acid-base and oxidation-reduction)
   3. Predicting the products of chemical reactions
   4. Concentrations of solutions
   5. Gravimetric analysis
   6. Acid-base and oxidation-reduction titrations (calculations and experimental techniques)

D. Gases
   1. Concept of gas pressure, manometers and barometers
   2. The Ideal Gas Law, Boyle's and Charles' Laws - calculations and graphical analysis
   3. Avogadro's Hypothesis
   4. Gas stoichiometry including calculations involving density and molar mass
   5. Dalton's Law of Partial Pressures
   6. Kinetic Molecular Theory
      a. Molecular velocities and gas effusion rates
      b. Maxwell's distribution of molecular velocities
   7. Deviations of real gases from the Ideal Gas Law

E. Thermochemistry
   1. Enthalpy change, Δ H and heats of formation
   2. Calorimetry - constant pressure and constant volume
   3. First Law of Thermodynamics

F. Electronic Structure of Atoms and Periodic Properties of Elements
   1. Experimental basis of quantum theory - wave and particle models (Bohr and Schrodinger)
   2. Atomic Orbitals
   3. Electron configurations - Pauli exclusion principle, Hund's rule, Shielding Effect
   4. Correlation of periodic chemical properties with electron structures
   5. Periodic Trends - effective nuclear charge, atomic radius, ionic radius, ionization energy, and electron affinity
   6. Interpretation of photoelectron spectra - relating energy level to ionization energy
   7. General properties of elements within the columns of the periodic table

G. Chemical Bonding and Molecular Geometry
   1. Ionic bonds - properties, Lewis dot structures, lattice energies, and ion sizes
   2. Covalent Bonding
      a. Lewis dot structures including expanded and incomplete octets
      b. Electronegativity and polarity of bonds
      c. Formal charges
      d. Resonance structures
   3. Calculation of the net enthalpy change by using bond energies
   4. Determination of molecular geometry using the VSEPR Theory
   5. Determination of all possible isomers of a substance
   6. Dipole moments (polarity of molecules)
   7. Determination of molecular geometry using valance bond theory and hybridization of atomic orbitals
   8. Delocalized molecular orbitals

H. Intermolecular Forces, Liquids, Solids, and Solutions
   1. Intermolecular Forces - hydrogen bonding, dipole-dipole, dispersion, ion-dipole
   2. Properties of liquids - surface tension, viscosity, properties of water
   3. Types of crystals - ionic, covalent, molecular and metallic
   4. Semi-conductors - basic understanding of p-type and n-type semi-conductors
   5. Phase changes - vapor pressure, molar heat of vaporization and fusion, critical temperature and pressure, phase diagrams
   6. Types of solutions and the solution process
   7. Concentration units - molarity, percent by mass, mole fraction
   8. The effect of temperature on solubility of solids in liquids
   9. The effect of pressure on the solubility of gases: Henry's Law
   10. Colloids

I. Chemical Kinetics
   1. Definition of chemical reaction rate
   2. Rate Laws - determination of the Order of a chemical reaction (zero, first or second) using experimental data
   3. Integrated Rate Laws (concentration vs. time) and graphical representations
   4. Potential Energy Diagrams and Activation Energy (Arrhenius Equation)
   5. Collision Theory and the effect on rates due to changes in concentration, temperature and surface area
   6. Reaction mechanisms and their relationship to rates (rate determining step)
   7. Catalysis

J. Chemical Equilibrium
   1. Concept of dynamic chemical equilibrium and the equilibrium constant, K_c and K_p
   2. Use of the equilibrium constant to predict the direction of a reaction and to calculate concentrations of equilibrium systems (I,C,E calculations)
   3. Le Châtelier's Principle - effect of stresses on an equilibrium system

K. Acids and Bases
   1. Arrhenius and Brønsted-Lowry definitions of acids and bases
   2. Properties of acids and bases in water
   3. Calculations involving K_w, pH, pOH
   4. Strengths of acids and bases and calculations using weak acid and base constants
   5. Molecular structure and strengths of acids
   6. Hydrolysis of salts
   7. Acid-base properties of oxides and hydroxides
   8. Lewis acids and bases

L. Acid Base Equilibria and Solubility Equilibria
   1. The common ion effect in acid-base equilibrium and application to buffer solutions
   2. Acid-base titrations and acid-base indicators - concepts, calculations and graphical analysis
   3. Solubility equilibria - K_{sp} calculations, predicting precipitation reactions
   4. Separation of ions by fractional precipitation
   5. The common ion effect, pH and complex ions in solubility equilibrium situations

M. Chemical Thermodynamics
   1. Entropy
   2. Reaction spontaneity and relationship to change in entropy
   3. Gibbs Free Energy (determines spontaneity)
   4. Gibbs-Helmholtz Equation
   5. Relationship between free energy and equilibrium

N. Electrochemistry
   1. Oxidation-Reduction reactions: oxidation numbers and balancing redox reactions
   2. Voltaic (Galvanic Cells): setup and calculation of voltages
   3. Relationship between voltage and equilibrium;
   4. Effect of concentration changes on voltage – the Nernst Equation
   5. Batteries and corrosion
   6. Electrolysis.

IV. INSTRUCTIONAL TECHNIQUES

A variety of instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Teaching techniques include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction and modeling of procedures
B. Flexible grouping
C. Differentiated tasks
D. Laboratory activities, demonstrations, and experiments that require collection, organization, representation, and analysis of data
E. Problem-based learning
F. Independent practice
G. Integration of technology into class activities
H. Visual models, animations, and video to illustrate or enhance class discussions

I. For strategies to differentiate for special education students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans, please consult the Accommodations and Modifications appendix in the appendices section of this document.

EVALUATION

The assessment tools the teacher employs to measure student mastery of course objectives include, but are not limited to, the following:

A. Baseline and benchmark assessments
B. Written tests and quizzes
C. Cumulative tests
D. Homework
E. Independent projects
F. Research papers
G. Presentations
H. Laboratory assignments and participation.

V. PROFESSIONAL DEVELOPMENT

Opportunities for professional development include:

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

APPENDIX I

Instructional Resources and Pacing Guide

Instructional resource: *Chemistry, Raymond Chang, 8th Edition; McGraw Hill*

Unit	Approximate number of teaching days
Matter and Measurement	4 – 6
Chemical Formulas and Equations	10 – 13
Reactions in Aqueous Solutions	10 – 13
Gases	8 – 10
Thermochemistry	6 – 8
Electronic Structure and Periodic Properties	10 – 13
Chemical Bonding and Molecular Structure	12 – 16
Intermolecular Forces, Solids, Liquids and Solutions	10 – 13
Kinetics	10 – 13
Equilibrium	8 – 10
Acids and Bases	10 – 13
Acid Base Equilibria and Solutions Equilibria	12 – 15
Chemical Thermodynamics	5 – 7
Electrochemistry	10 – 13

APPENDIX II

New Jersey Student Learning Standards for Science

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-PS1-3. 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-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-PS1-7. Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

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

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 III

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.

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

APPENDIX IV

New Jersey Student Learning Standards for 21st Century Life & Careers

Career Ready Practices
CRP2. Apply appropriate academic and technical skills
CRP4. Communicate clearly and effectively and with reason
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
CRP11. Use technology to enhance productivity.

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

APPENDIX V

New Jersey Student Learning Standards for English Language Arts

Progress Indicators for Reading Science and Technical Subjects

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.11-12.3. 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.11-12.8. 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.

The entire standards document can be viewed at http://www.state.nj.us/education/cccs/2016/ela/

APPENDIX VI

New Jersey Student Learning Standards for Mathematical Practice

SMP1 – Make sense of problems and persevere in solving them
SMP2 – Reason abstractly and quantitatively
SMP3 – Construct viable arguments and critique the reasoning of others
SMP4 – Model with mathematics
SMP5 – Use appropriate tools strategically
SMP6 – Attend to precision
SMP7 – Look for and make use of structure
SMP8 – Look for and express regularity in repeated reasoning.

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

APPENDIX VII

Integrated Accommodations and Modifications for Special Education Students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans (N.J.A.C. 6A: 8)

Special Education
ENVIRONMENT
Preferential Seating
Adjust time for completion of assignments when needed
Adjust length of assignments when needed
Allow additional oral response time

Break tasks (including long range assignments) into manageable steps
Provide copies of notes
Reduce the number of problems on a page
Provide assistance with organizing a notebook or folder
Repeat/ clarify directions when needed
Make frequent checks for work/assignment completion.
Modify homework and class work if needed
Extend time on tests/quizzes
Provide study guides for tests
Provide oral component when needed
Modify format when needed- (ex: limit choices, word bank, shortened written responses)
Allow a private workspace when needed (study carrel, separate desk, desk away from the group)
Allow opportunities for movement (e.g., help with supplies, change to different part of room to work, carry messages to office)
Assist the student to keep only the materials required for the lesson on the desktop
Provide a seat away from distractions (or noise)

MATERIAL/BOOKS/EQUIPMENT
Allow use of a calculator
Allow use of a number line
Allow use of counting chips
Modify worksheets
Provide visual aids (pictures, flash cards, etc.)
Provide auditory aids (cues, tapes, etc.)
Use manipulatives
Provide hands-on learning activities
INSTRUCTIONAL STRATEGIES
Check work in progress
Provide immediate feedback
Provide extra drill/practice
Provide review sessions
Provide models
Highlight key words

Provide pictures/charts
Use mnemonics
Support auditory presentations with visuals
Have student restate information
Provide lecture notes/outline
Give oral reminders
Give visual reminders
Review directions
Use graphic organizers
Assign partners
Repeat instructions
Display key vocabulary
Monitor assignments
Provide visual reinforcement
Provide concrete examples
Use vocabulary word bank

ORGANIZATION
Post assignments
Provide a desktop list of tasks
Give one paper at a time
Provide extra space for work
List sequential steps
Provide folders to hold work
Post routines
Use pencil box for tools
Reorganize poorly designed worksheets to create simple, easy-to-follow layouts and formats
Give advance warning when transition is going to take place
Provide structure for success
Provide a contract, timer, etc., for self-monitoring
Give the student a prompt when he/she is off task (e.g., move close to the student, speak to the student, etc.)
TEST/QUIZZES/TIME
Give prior notice of test

Provide oral testing
Provide extra time for written work
Provide modified tests
Rephrase test questions/directions
Preview test procedures
Provide shortened tasks
Provide extra time for tests
Read test to student
Provide test study guides
Limit multiple choice options
Provide extra time for projects
Pace long term projects
Simplify test wording
Provide hands-on projects
Allow extra response time
ENGLISH LANGUAGE LEARNERS

GRADING
Standard Grades vs. Pass/Fail
CONTINUUM OF ENGLISH LANGUAGE DEVELOPMENT
Pre K-K WIDA CAN DO Descriptors
Grades 1-2 WIDA CAN DO Descriptors
Grades 3-5 WIDA CAN DO Descriptors
Grades 6-8 WIDA CAN DO Descriptors
Grades 9-12 WIDA CAN DO Descriptors
SIOP COMPONENTS AND FEATURES
PREPARATION
Write content objectives clearly for students
Write language objectives clearly for students
Choose content concepts appropriate for age and educational background levels of students
Identify supplementary materials to use
Adapt content to all levels of students proficiency
Plan meaningful activities that integrate lesson concepts with language practices opportunities for reading, writing, listening, and/or speaking
BUILDING BACKGROUND
Explicitly link concepts to students' backgrounds and experiences

Explicitly link past learning and new concepts
Emphasize key vocabulary for students
COMPREHENSIBLE INPUT
Use speech appropriate for students' proficiency level
Explain academics tasks clearly
Use a variety of techniques to make content concepts clear (e.g. modeling, visuals, hands-on activities, demonstrations, gestures, body language)
STRATEGIES
Provide ample opportunities for students to use strategies (e.g. problem solving, predicting, organizing, summarizing, categorizing, evaluating, self-monitoring)
Use scaffolding techniques consistently throughout lesson
Use a variety of question types including those that promote higher-order thinking skills throughout the lesson
INTERACTION
Provide frequent opportunities for interaction and discussion between teacher/students and among students about lessons concepts, and encourage elaborated responses
Use group configurations that support language and content objectives of the lesson
Provide sufficient wait time for student responses consistently
Give ample opportunities for students to clarify key concepts in LI as needed with aide, peer, or LI text
PRACTICE/APPLICATION
Provide hands-on materials and/ manipulatives for students to practice using new content knowledge

Provide activities for students to apply content and language knowledge in the classroom
Provide activities that integrate all language skills
LESSON DELIVERY
Support content objectives clearly
Support language objectives clearly
Engage students approximately 90-100% of the period
Pace the lesson appropriately to the students' ability level
REVIEW/EVALUATION
Give a comprehensive review of key vocabulary
Give a comprehensive review of key content concepts
Provide feedback to students regularly on their output
Conduct assessments of students comprehension and learning throughout lesson and all lesson objectives

STUDENTS AT RISK OF SCHOOL FAILURE (I&RS RESOURCE MANUAL)

ACADEMICS
Provide necessary services (Lit Support, Math Support, OT, PT, speech, etc.)
Literacy Support Interventions (Appendix B of IS forms)
Prompt before directions/questions are verbalized with visual cue between teacher and student

Task list laminated and placed on desk for classroom routines and organization
Preferential seating
Provide structure and positive reinforcements
Sustained working time connected to reward (If/Then statement)
Frequently check for understanding
Graphic organizers
Tracker
Slant board
Access to accurate notes
Additional time to complete tasks/long-term projects with adjusted due dates
Limit number of items student is expected to learn at one time
Break down tasks into manageable units
Directions repeated, clarified, or reworded
Frequent breaks during class
Allow verbal rather than written responses
Modify curriculum content based on student's ability level
Reduce readability level of materials
Allow typed rather than handwritten responses

Use of calculator
Use of a math grid
Provide models/organizers to break down independent tasks
Access to electronic text (e.g. Downloaded books)
Provide books on tape, CD, or read aloud computer software
Provide opportunities for using a Chromebook as well as assistive technologies
Provide buddy system
Adjust activity, length of assignment, and/or number of problems, including homework
Provide assessments in a small group setting
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Communication with parents
Gradual release of responsibility related to writing prompts (Proximity, Sentence Starter, Attempt independently)
Rubric-based checklist
Target specific number of details and focus on organization with post-its
Accept late work/homework without penalty
Previewing material (access to PowerPoint slides, novels, syllabus, study guides when available)
SOCIAL/EMOTIONAL
Children's books addressing presenting problem

Student jots down presenting problem and erase when it goes away
Meet with guidance counselor
Student jots down presenting problem and erase when it goes away
Attendance plan
Utilize nurse during episodes of presenting problem
Provide short breaks
Attendance plan
Communication with parents
Assign "jobs" to reduce symptoms
Counseling check-ins
Praise whenever possible
ATTENTION/FOCUS
Seat student near front of room
Preferential seating
Monitor on-task performance
Arrange private signal to cue student to off-task behavior
Establish and maintain eye contact when giving oral directions
Stand in proximity to student to focus attention

Provide short breaks when refocusing is needed
Use study carrel
Arrange physical layout to limit distractions
Frequently ask questions to engage student
Refocusing and redirection
Behavior/time management system
Group directions 1 step at a time
Assign "jobs" to reduce symptoms
Arrange physical layout to limit distractions
Frequently ask questions to engage student
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Extended time on assignments/assessments
Provide assessments in a small group setting
Provide buddy system
Establish and maintain eye contact when giving oral directions
Permit the use of headphones while working
SCHOOL REFUSAL/ELEVATED ABSENTEEISM
Attendance plan

CURRICULUM
Acceleration
Compacting
Telescoping
Advanced Placement Courses
INSTRUCTION
Grouping
Independent Study
Differentiated Conferencing
Project-Based Learning
Competitions
Cluster Grouping Model with Flexible Grouping
Differentiated Instruction
Summer Work
Parent Communication

WESTFIELD PUBLIC SCHOOLS
Westfield, New Jersey

Office of Instruction

Course of Study

EARTH SCIENCE: 7211

School.....Westfield High School
Department .....Science
Length of Course .....One Year
Credit 6.0
Grade Levels.....9, 10, 11, 12
Prerequisite.....None
Date .....

I. RATIONALE, DESCRIPTION AND PURPOSE

Earth Science is an introductory laboratory course designed to develop students' understanding of and appreciation for the fascinating and dynamic planet Earth. The course covers the four main Earth systems: Meteorology, Oceanography, Geology and Space Science as well as reinforcement of basic science ideas and practices. Students explore and appreciate the complexity of these systems and how they interrelate. Through classroom instruction, laboratory experiments and activities, demonstrations, simulations, and content-related multimedia presentations, students learn about the planet on which they live and how to apply their learning to observations made in their everyday lives.

Earth Science is designed to encourage students to gain an understanding of the discipline through the following processes: observing, measuring, predicting, experimenting, classifying, inferring, and generating conclusions. Students challenge themselves in order to gain greater comprehension of the mechanics of the world in which they live through an understanding of the processes that have formed the Earth as we know it and that continue to play a role in Earth's dynamic systems. Students also gain a foundation of basic skills that allows for further success in future courses.

Upon completion of this course, students have learned to observe the planet Earth scientifically. Successful completion of Earth Science provides the students with a foundation for further studies in the sciences and a basis for understanding everyday observations of the physical world around them.

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 the 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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2

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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP11

C. 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 P1,2,3
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.3
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,6,8

D. 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 P4,6,7,8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.4
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,8

E. 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 P4,7,8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.8
New Jersey Student Learning Standards for Mathematical Practice SMP8

F. 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 P2,7,8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects WHST.11-12.1, 11-12.8
New Jersey Student Learning Standards for 21st Century Life and Careers CRP4,8
New Jersey Student Learning Standards for Mathematical Practice SMP3

G. Demonstrate proficiency in the use of laboratory technology including, but not limited to, data collection probe ware, and video analysis software and research microscopes.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.11-12.9
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,11

Earth Science Practices
Students:

A. Explain, illustrate, and model how weather and climate are defined and related and how energy is transferred through the atmosphere
New Jersey Student Learning Standards for Science: HS-ESS1-1, HS-ESS2-4, HS-ESS2-5, HS-ESS2-6, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

B. Demonstrate knowledge of the Earth's oceans, properties of seawater, ocean floor topography, and the role that oceans play in the planet's other systems
New Jersey Student Learning Standards for Science: HS-ESS1-5, HS-ESS2-4, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

C. Analyze the physical makeup of Earth and describe the chemical properties and physical characteristics of geological materials and their relationship to other Earth systems
New Jersey Student Learning Standards for Science: HS-ESS1-2, 5, 6, HS-ESS2-1-3, HS-ESS3-1, HS-ESS3-4, HS-ESS3-5, HS-ESS3-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

D. Demonstrate an understanding that the Earth is a dynamic planet that continues to change through geomorphic processes
New Jersey Student Learning Standards for Science: HS-ESS1-5, HS-ESS1-6, HS-ESS2-1, HS-ESS2-2, HS-ESS2-3 HS-ESS3-1
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

E. Demonstrate comprehension of the methods used to collect scientific data about the structure and dynamics of the Earth
New Jersey Student Learning Standards for Science: HS-ESS1-5, HS-ESS1-6, HS-ESS2-1 HS-ESS2-2, HS-ESS3-1
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

F. Employ the use of maps that describe geographic features of Earth's surface and interpret map features such as latitude, longitude, contour lines and projection methods
New Jersey Student Learning Standards for Science: HS-ESS1-5, HS-ESS2-1, HS-ESS2-2, HS-ESS3-1
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

G. Measure volume, density, distance, length, mass and weight to understand the structure and dynamics of Earth's systems
New Jersey Student Learning Standards for Science: HS-ESS1-5, HS-ESS2-1
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

H. Describe our solar system, galaxy and other features of the universe
New Jersey Student Learning Standards for Science: HS-ESS1-1, HS-ESS1-2, HS-ESS1-3, HS-ESS1-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

I. Explain how the Earth, Moon and Sun are interrelated and determine the properties of Earth's systems
New Jersey Student Learning Standards for Science: HS-ESS1-1, HS-ESS1-2, HS-ESS1-4, HS-ESS1-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

J. Demonstrate proper laboratory skills, infer and predict outcomes of experiments, gather experimental data, and interpret and apply information gained in laboratory work and analyses to reinforce the concepts being studied
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

K. Demonstrate proper media research techniques and study skills through the use of available resources
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

L. Relate course content to current events
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

M. Relate course content to relevant careers.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP 2,4,8,11

III. CONTENT, SCOPE AND SEQUENCE

Earth Science principles provide the opportunity for students to develop an understanding of our world and of the processes that formed it, change it, and make it unique. The robustness and the fragility of our Earth are underlying themes of classroom instruction and discussion. Due to the nonlinear nature of the course content, the four main units (B through E below) comprising Earth Science may be taught in any logical sequence. Focus on current event discussion and the development of study skills throughout the course are a vital part of student growth in Earth Science.

A. Introduction to Earth Science
   1. Qualitative vs. quantitative observations
   2. Measurement units
      a. Metric System / System International (SI)
      b. English System
      c. Conversions between systems
   3. Matter and Energy
      a. Phases of matter
      b. Phase change
      c. Heat vs. temperature
      d. Molecular motion

B. Meteorology
   1. Earth's atmosphere
      a. Layers of the atmosphere
      b. Composition of air
      c. Air pressure
      d. Humidity and relative humidity
      e. Temperature variations
   2. Heat transfer and budget
   3. Greenhouse Effect and Global Warming
   4. Global/prevailing winds, air masses, and frontal systems
   5. Dew point and clouds
   6. Types of precipitation
   7. NJ, US, and global average amounts of precipitation
   8. Severe weather
      a. Hurricanes
      b. Tornados
      c. Lightning
   9. Prevailing weather patterns
   10. The Coriolis Effect
   11. Weather maps and station models
   12. Climate
      a. Climate controls
      b. World climate regions
      c. The difference between weather and climate
   13. Polar ice and Polar weather

C. Oceanography
   1. Ocean floor topography
   2. Ocean floor rifts and vents
   3. Plate tectonics
   4. Ocean currents
   5. Salinity
   6. Wave action
   7. Beach erosion

D. Geology
   1. Earth's Structure
      a. Earth's layers
      b. Minerals, crystals, and rocks
      c. Basic chemistry of mineral formation
      d. Basic crystal structures
      e. Minerals and their physical properties
      f. Formation and characteristics of Igneous, Sedimentary, and Metamorphic Rocks
      g. The rock cycle
   2. Processes
      a. Chemical and mechanical weathering
      b. Weathering vs. Erosion
      c. Sand dunes
      d. Soil formation and conservation
      e. Residual vs. transported sedimentation
      f. The Water Cycle, energy source, six phase changes, and evapotranspiration
      g. Ground water, water table, aquifers, permeability, well vs. spring, contamination and conservation of water sources
   3. Volcanism and The Ring of Fire
      a. Volcanoes
      b. Volcanic eruptions
      c. Intrusive vs. extrusive
   4. Earthquakes
      a. Causes, *S*, *P* and *L* Waves, Richter Scale, Fault vs. Rift and fault types
      b. Earthquake safety
   5. Glaciers
      a. Formation, types, movement, and resulting surface features
      b. The last Ice Age
   6. Maps
      a. Latitude and Longitude
      b. Map projections
      c. Topographic maps and contour lines
      d. Generating surface descriptions from maps

E. Space Science
   1. Studying space and data collection techniques
      a. Refracting telescopes
      b. Reflecting telescopes
      c. Radio telescopes
      d. Space telescopes
   2. The formation and lives of stars
      a. Properties
      b. Evolution and life cycle
   3. Our Star - The Sun
      a. Structure
      b. Dynamic processes
   4. The Milky Way
      a. Characteristics
      b. Earth's place
   5. The Universe
      a. Galaxies
      b. Expansion
      c. Big Bang Theory
   6. Earth's Motions Relative to the Solar System
      a. Rotation
      b. Revolution
      c. Seasons
      d. Phases of the Moon
      e. Eclipses

IV. INSTRUCTIONAL TECHNIQUES

A variety of instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Teaching techniques include, but are not limited to, the following:

A. Teacher directed discussion and directed questioning
B. Laboratory work that provides hands-on applications of course material
C. Physical models that illustrate content and provide students a space-filling observation of content presented
D. Visual models to appeal to all classroom learners
E. Simulations to facilitate understanding of concepts
F. Relating the ideas taught in class to students' everyday observations of their environment
G. Introduction of current events, such as severe weather and geologic events
H. Differentiated instruction specifically designed to meet the needs of all learners
I. Computer aided laboratory work and research
J. Demonstrations to illustrate and reinforce classroom instructional content
K. Cooperative learning and small group instruction
L. Internet and streaming resources
M. Concept reinforcement through reading assignments, activities and worksheets
N. Use of class Chromebooks to enhance student learning

O. For strategies to differentiate for special education students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans, please consult the Accommodations and Modifications appendix in the appendices section of this document.

V. EVALUATION

The assessment tools the teacher employs to measure student master of course objectives include, but are not limited to, the following:

A. Baseline and benchmark assessments
B. Laboratory assignments
B. Homework
C. Written tests and quizzes
D. Cumulative tests
E. Independent research assignments
F. Group projects
G. Class Presentations
H. Class participation.

VI. PROFESSIONAL DEVELOPMENT

Opportunities for professional development include:

A. Teacher workshops, teacher conferences, and conventions
B. Access to professional books and journals
C. Collaboration with other colleagues
D. College courses
E. Professional organizations
F. In-service trainings addressing specific department, school and district goals.

APPENDIX I

Instructional Resources and Pacing Guide

Instructional resource: *Earth Science, Tarbuck and Lutgens, 2006; Pearson Prentice Hall*

Unit	Approximate number of teaching days
Introduction to Earth Science	5 - 10
Energy in the Atmosphere	20 - 25
Water in the Atmosphere	20 - 25
Severe Weather & Forecasting	20 - 35
Climatology	15 - 20
Oceanography	20 - 30
Geology	30 - 40
Astronomy	5 - 10

APPENDIX II

New Jersey Student Learning Standards for Science

HS-ESS1-1. Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.
HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
HS-ESS1-3. Communicate scientific ideas about the way stars, over their life cycle, produce elements.
HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.
HS-ESS1-5. Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
HS-ESS1-6. Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
HS-ESS2-1. Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-3. Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*
HS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
HS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

NGSS Appendix – 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

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 III

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.

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

APPENDIX IV

New Jersey Student Learning Standards for 21st Century Life & Careers

Career Ready Practices
CRP2. Apply appropriate academic and technical skills
CRP4. Communicate clearly and effectively and with reason
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
CRP11. Use technology to enhance productivity.

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

APPENDIX V

New Jersey Student Learning Standards for English Language Arts

Progress Indicators for Reading Science and Technical Subjects

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.11-12.3. 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.11-12.8. 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.

The entire standards document can be viewed at http://www.state.nj.us/education/cccs/2016/ela/

APPENDIX VI

New Jersey Student Learning Standards for Mathematical Practice

SMP1 – Make sense of problems and persevere in solving them
SMP2 – Reason abstractly and quantitatively
SMP3 – Construct viable arguments and critique the reasoning of others
SMP4 – Model with mathematics
SMP5 – Use appropriate tools strategically
SMP6 – Attend to precision
SMP7 – Look for and make use of structure
SMP8 – Look for and express regularity in repeated reasoning.

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

APPENDIX VII

Integrated Accommodations and Modifications for Special Education Students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans (N.J.A.C. 6A: 8)

Special Education
ENVIRONMENT
Preferential Seating
Adjust time for completion of assignments when needed
Adjust length of assignments when needed
Allow additional oral response time
Break tasks (including long range assignments) into manageable steps
Provide copies of notes
Reduce the number of problems on a page
Provide assistance with organizing a notebook or folder
Repeat/ clarify directions when needed
Make frequent checks for work/assignment completion.
Modify homework and class work if needed

Extend time on tests/quizzes
Provide study guides for tests
Provide oral component when needed
Modify format when needed- (ex: limit choices, word bank, shortened written responses)
Allow a private workspace when needed (study carrel, separate desk, desk away from the group)
Allow opportunities for movement (e.g., help with supplies, change to different part of room to work, carry messages to office)
Assist the student to keep only the materials required for the lesson on the desktop
Provide a seat away from distractions (or noise)
MATERIAL/BOOKS/EQUIPMENT
Allow use of a calculator
Allow use of a number line
Allow use of counting chips
Modify worksheets
Provide visual aids (pictures, flash cards, etc.)
Provide auditory aids (cues, tapes, etc.)

Use manipulatives
Provide hands-on learning activities
INSTRUCTIONAL STRATEGIES
Check work in progress
Provide immediate feedback
Provide extra drill/practice
Provide review sessions
Provide models
Highlight key words
Provide pictures/charts
Use mnemonics
Support auditory presentations with visuals
Have student restate information
Provide lecture notes/outline
Give oral reminders
Give visual reminders

Review directions
Use graphic organizers
Assign partners
Repeat instructions
Display key vocabulary
Monitor assignments
Provide visual reinforcement
Provide concrete examples
Use vocabulary word bank
ORGANIZATION
Post assignments
Provide a desktop list of tasks
Give one paper at a time
Provide extra space for work
List sequential steps
Provide folders to hold work

Post routines
Use pencil box for tools
Reorganize poorly designed worksheets to create simple, easy-to-follow layouts and formats
Give advance warning when transition is going to take place
Provide structure for success
Provide a contract, timer, etc., for self-monitoring
Give the student a prompt when he/she is off task (e.g., move close to the student, speak to the student, etc.)
TEST/QUIZZES/TIME
Give prior notice of test
Provide oral testing
Provide extra time for written work
Provide modified tests
Rephrase test questions/directions
Preview test procedures
Provide shortened tasks
Provide extra time for tests

Read test to student
Provide test study guides
Limit multiple choice options
Provide extra time for projects
Pace long term projects
Simplify test wording
Provide hands-on projects
Allow extra response time
ENGLISH LANGUAGE LEARNERS
GRADING
Standard Grades vs. Pass/Fail
CONTINUUM OF ENGLISH LANGUAGE DEVELOPMENT
Pre K-K WIDA CAN DO Descriptors
Grades 1-2 WIDA CAN DO Descriptors
Grades 3-5 WIDA CAN DO Descriptors
Grades 6-8 WIDA CAN DO Descriptors
Grades 9-12 WIDA CAN DO Descriptors

SIOP COMPONENTS AND FEATURES
PREPARATION
Write content objectives clearly for students
Write language objectives clearly for students
Choose content concepts appropriate for age and educational background levels of students
Identify supplementary materials to use
Adapt content to all levels of students proficiency
Plan meaningful activities that integrate lesson concepts with language practices opportunities for reading, writing, listening, and/or speaking
BUILDING BACKGROUND
Explicitly link concepts to students' backgrounds and experiences
Explicitly link past learning and new concepts
Emphasize key vocabulary for students
COMPREHENSIBLE INPUT
Use speech appropriate for students' proficiency level
Explain academics tasks clearly
Use a variety of techniques to make content concepts clear (e.g. modeling, visuals, hands-on activities, demonstrations, gestures, body language)
STRATEGIES

Provide ample opportunities for students to use strategies (e.g. problem solving, predicting, organizing, summarizing, categorizing, evaluating, self-monitoring)
Use scaffolding techniques consistently throughout lesson
Use a variety of question types including those that promote higher-order thinking skills throughout the lesson
INTERACTION
Provide frequent opportunities for interaction and discussion between teacher/students and among students about lessons concepts, and encourage elaborated responses
Use group configurations that support language and content objectives of the lesson
Provide sufficient wait time for student responses consistently
Give ample opportunities for students to clarify key concepts in LI as needed with aide, peer, or LI text
PRACTICE/APPLICATION
Provide hands-on materials and/ manipulatives for students to practice using new content knowledge
Provide activities for students to apply content and language knowledge in the classroom
Provide activities that integrate all language skills
LESSON DELIVERY
Support content objectives clearly
Support language objectives clearly
Engage students approximately 90-100% of the period
Pace the lesson appropriately to the students' ability level

REVIEW/EVALUATION
Give a comprehensive review of key vocabulary
Give a comprehensive review of key content concepts
Provide feedback to students regularly on their output
Conduct assessments of students comprehension and learning throughout lesson and all lesson objectives

STUDENTS AT RISK OF SCHOOL FAILURE (I&RS RESOURCE MANUAL)

ACADEMICS
Provide necessary services (Lit Support, Math Support, OT, PT, speech, etc.)
Literacy Support Interventions (Appendix B of IS forms)
Prompt before directions/questions are verbalized with visual cue between teacher and student
Task list laminated and placed on desk for classroom routines and organization
Preferential seating
Provide structure and positive reinforcements
Sustained working time connected to reward (If/Then statement)
Frequently check for understanding
Graphic organizers
Tracker
Slant board

Access to accurate notes
Additional time to complete tasks/long-term projects with adjusted due dates
Limit number of items student is expected to learn at one time
Break down tasks into manageable units
Directions repeated, clarified, or reworded
Frequent breaks during class
Allow verbal rather than written responses
Modify curriculum content based on student's ability level
Reduce readability level of materials
Allow typed rather than handwritten responses
Use of calculator
Use of a math grid
Provide models/organizers to break down independent tasks
Access to electronic text (e.g. Downloaded books)
Provide books on tape, CD, or read aloud computer software
Provide opportunities for using a Chromebook as well as assistive technologies
Provide buddy system
Adjust activity, length of assignment, and/or number of problems, including homework

Provide assessments in a small group setting
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Communication with parents
Gradual release of responsibility related to writing prompts (Proximity, Sentence Starter, Attempt independently)
Rubric-based checklist
Target specific number of details and focus on organization with post-its
Accept late work/homework without penalty
Previewing material (access to PowerPoint slides, novels, syllabus, study guides when available)
SOCIAL/EMOTIONAL
Children's books addressing presenting problem
Student jots down presenting problem and erase when it goes away
Meet with guidance counselor
Student jots down presenting problem and erase when it goes away
Attendance plan
Utilize nurse during episodes of presenting problem
Provide short breaks
Attendance plan
Communication with parents

Assign "jobs" to reduce symptoms
Counseling check-ins
Praise whenever possible
ATTENTION/FOCUS
Seat student near front of room
Preferential seating
Monitor on-task performance
Arrange private signal to cue student to off-task behavior
Establish and maintain eye contact when giving oral directions
Stand in proximity to student to focus attention
Provide short breaks when refocusing is needed
Use study carrel
Arrange physical layout to limit distractions
Frequently ask questions to engage student
Refocusing and redirection
Behavior/time management system
Group directions 1 step at a time
Assign "jobs" to reduce symptoms

Arrange physical layout to limit distractions
Frequently ask questions to engage student
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Extended time on assignments/assessments
Provide assessments in a small group setting
Provide buddy system
Establish and maintain eye contact when giving oral directions
Permit the use of headphones while working
SCHOOL REFUSAL/ELEVATED ABSENTEEISM
Attendance plan

GIFTED AND TALENTED STUDENTS

CURRICULUM
Acceleration
Compacting
Telescoping
Advanced Placement Courses
INSTRUCTION
Grouping

Independent Study
Differentiated Conferencing
Project-Based Learning
Competitions
Cluster Grouping Model with Flexible Grouping
Differentiated Instruction
Summer Work
Parent Communication

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

INTEGRATION OF DESIGN, ENGINEERING & ARCHITECTURE – HONORS: 7452

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

I. RATIONALE, DESCRIPTION AND PURPOSE

Integration of Design, Engineering, and Architecture (IDEA) Honors introduces students to various disciplines within the engineering and architectural fields. This honors level course integrates science and mathematics knowledge that students have learned in previous courses and applies these to design, engineering and architecture. Students with a strong aptitude in math and science should consider engineering or architectural careers, but few have been exposed to these fields. This course introduces students to engineering and architectural fields by placing science, technology, engineering and math into an integrated societal context.

There is a demand for Science, Technology, Engineering and Mathematics (STEM) education. This course addresses that need directly. The course employs problem-based and project-based learning (PBL) as applied by students and professionals in these fields. PBL requires applying critical-thinking skills and problem-solving skills through a hands-on approach for designing and developing creative solutions to real-world problems. Students will work independently and collaboratively, developing interpersonal skills necessary for their future studies and professional 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.

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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2

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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP11

C. 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 P1,2,3
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.3
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,6,8

D. 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 P4,6,7,8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.4
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,8

E. 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 P4,7,8
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.8
New Jersey Student Learning Standards for Mathematical Practice SMP8

F. 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 P2,7,8
New Jersey Student Learning Standards for ELA: Science & Technical Subjects WHST.11-12.1, 11-12.8
New Jersey Student Learning Standards for 21st Century Life and Careers CRP4,8
New Jersey Student Learning Standards for Mathematical Practice SMP3

G. Demonstrate proficiency in the use of laboratory technology including, but not limited to, data collection probe ware, and video analysis software and research microscopes.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.9
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,11

IDEA Practices

Students:

A. Apply the engineering design process to solve real-world problems in engineering and architecture
New Jersey Student Learning Standards for Science HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P6
New Jersey Student Learning Standards for Mathematical Practice SMP1,5,7
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP6

B. Evaluate the stresses and failure modes of structural members under various loading conditions and optimize shape and material accordingly
New Jersey Student Learning Standards for Science HS-PS2-1, HS-PS2-2, HS-PS2-3, HS-PS2-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P5
New Jersey Student Learning Standards for Mathematical Practice SMP2,4,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

C. Evaluate structural material properties to satisfy aesthetic requirements and environmental loading conditions
New Jersey Student Learning Standards for Science HS-PS2-6, HS-ETS1-3
New Jersey Student Learning Standards for Science: Science and Engineering Practices P6
New Jersey Student Learning Standards for Mathematical Practice SMP2
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

D. Design, draw and construct a structural model that demonstrates the interaction of loads, member sizes and stresses
New Jersey Student Learning Standards for Science HS-ETS1-4, HS-PS2-3
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2,3
New Jersey Student Learning Standards for Mathematical Practice SMP4,5,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP6

E. Evaluate power generation and distribution using various energy sources, including fossil fuels, nuclear, hydroelectric, wind, solar and other alternative sources
New Jersey Student Learning Standards for Science HS-ESS3-2
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.8, RST.11-12.9
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Mathematical Practice SMP3
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP4

F. Research and evaluate the environmental impact of various energy sources and the technologies employed to mitigate these effects
New Jersey Student Learning Standards for Science HS-ETS1-1, HS-ETS1-3, HS-ESS2-2, HS-ESS3-4, HS-LS2-7
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.8, RST.11-12.9, RST.11-12.10
New Jersey Student Learning Standards for Science: Science and Engineering Practices P7,8
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP7,8

G. Research and evaluate water conservation, water treatment, waste management, and reclamation technologies
New Jersey Student Learning Standards for Science HS-ETS1-1, HS-ETS1-3, HS-ESS3-3, HS-ESS3-4, HS-LS2-7
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.8, RST.11-12.9, RST.11-12.10
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP2,4,5,7

H. Differentiate between analog and digital circuitry and design logic circuits
New Jersey Student Learning Standards for Science HS-PS4-5
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

I. Apply principles of fluid dynamics to the design of hydraulic and pneumatic mechanisms
New Jersey Student Learning Standards for Science HS-PS3-2
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2,5
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP2

J. Apply work, energy, and kinematics principles to mechanisms that convert translational motions to rotational motions or visa-versa
New Jersey Student Learning Standards for Science HS-PS3-2, HS-PS3-3
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

K. Research and critically evaluate robotics, automation, or transportation technologies
New Jersey Student Learning Standards for Science HS-ETS1-1, HS-ETS1-3, HS-ETS1-4
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.8, RST.11-12.9, RST.11-12.10
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP4,5,7

L. Apply heat transfer principles of conduction, convection, and radiation to building design
New Jersey Student Learning Standards for Science HS-PS3-2, HS-PS3-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P5
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

M. Interpret process flow diagrams and analyze a process utilizing material and energy balances
New Jersey Student Learning Standards for Science HS-PS1-4, HS-PS1-5, HS-PS3-1
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4
New Jersey Student Learning Standards for Mathematical Practice SMP4,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

N. Analyze environmental sustainability and design principles, including siting, climate, and regional analyses
New Jersey Student Learning Standards for Science HS-ESS3-1, HS-ESS3-2, HS-ESS3-3, HS-ESS3-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P6
New Jersey Student Learning Standards for Mathematical Practice SMP3,5
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP4

O. Apply the Universal Building Code or other relevant construction codes to a design
New Jersey Student Learning Standards for Science HS-ETS1-1, HS-ETS1-3
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.10
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Mathematical Practice SMP2,5
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP8

P. Create drawings and models that communicate essential design information
New Jersey Student Learning Standards for Science HS-ETS1-4
New Jersey Student Learning Standards for ELA: Science & Technical Subjects WHST.11-12.6, WHST.11-12.7
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2
New Jersey Student Learning Standards for Mathematical Practice SMP4,5
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP4

Q. Design, draw and construct an architectural model that demonstrates the interactions of form and function and space and environment
New Jersey Student Learning Standards for Science: Science and Engineering Practices P2
New Jersey Student Learning Standards for Mathematical Practice SMP2
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP6

R. Evaluate a design through economic analysis or sustainability considerations
New Jersey Student Learning Standards for Science HS-ESS3-2
New Jersey Student Learning Standards for Science: Science and Engineering Practices P7
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP4

S. Research licensing requirements and evaluate ethics in engineering and architectural case studies
New Jersey Student Learning Standards for Science HS-ETS1-1
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.1, RST.11-12.9, RST.11-12.10
New Jersey Student Learning Standards for Science: Science and Engineering Practices P8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP4

T. Critically read and analyze studies published in primary journals
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.1, RST.11-12.4, RST.11-12.8
New Jersey Student Learning Standards for Science: Science and Engineering Practices P4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP7,8

U. Design controlled experiments for independent research, compile and analyze data, and present and defend conclusions
New Jersey Student Learning Standards for ELA: Science & Technical Subjects RST.11-12.3, WHST.11-12.9
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3
New Jersey Student Learning Standards for Mathematical Practice SMP4,6
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP7,8

V. Relate course content to relevant careers.
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers: CRP10

III. CONTENT, SCOPE, AND SEQUENCE

This course will apply theoretical concepts learned in prior science and math courses to real-world scenarios in the engineering and architectural fields.

A. General Science, Technology, Engineering and Mathematics (STEM) Techniques
   1. The design process: design goals, design specifications, morphological charts, alternative solutions, and troubleshooting
   2. Technical writing and documentation: proposals, memos, and resumes
   3. Presentation skills
   4. Equipment safety
   5. 2D and 3D sketching and drawing: isometric, oblique, and orthographic drawings
   6. Capital investments, expenses, and return on investment
   7. Ethics and Professional Codes of Conduct
   8. Education and licensing requirements

B. Civil and Structural Engineering
   1. Statics: net force and torque
   2. Stress: compression, tension, bending and shear
   3. Strain: deformation of materials under loads
   4. Strength of materials: tensile strength, compressive strength, shear strength, and deformation
   5. Beam loading: compression, tension, and bending
   6. Stability: buckling
   7. Shear and bending diagrams
   8. Material properties: elasticity, Young's Modulus, yield stress, and ultimate strength
   9. Structural analysis and construction techniques
   10. Graphical and analytical statics

C. Environmental Engineering
   1. Energy sources, power generation and distribution
   2. Water resources and treatment, waste management, reclamation of waste materials, urban planning, greenhouse gases, and stack emissions
   3. Urban systems: electrical, water, sewage, fuel, and transportation
   4. Transportation systems: individual, mass transit, and alternatives

D. Electrical Engineering
   1. Electrical generation and distribution: AC vs. DC
   2. Power generation: combustion of fossil fuels, nuclear power, and alternative sources such as solar, wind, water, geothermal, and fuel cells
   3. Electronic components and their application in basic circuits
   4. Logic gates, ladder logic, and Boolean algebra

E. Mechanical Engineering
   1. Motion: translational and rotational kinematics
   2. Force and torque: translational and rotational dynamics
   3. Work and energy: translational and rotational energy
   4. Mechanisms: translational and rotational kinematics, dynamics and energy
   5. Fluids: hydraulics and pneumatics
   6. Thermodynamics: gas and steam cycles, work, and efficiency
   7. Heat Transfer: heat capacitance, conduction, convection, and radiation

F. Chemical Engineering and Materials Science
   1. Metal, polymer, ceramic, and composite materials
   2. Flow chart notation and process flow diagrams
   3. Unit operations: reactions, treatment, and separation techniques
   4. Process equipment and control systems
   5. Air and effluent quality control
   6. Pharmaceutical, oil, and chemical industries

G. Architecture and Architectural Engineering
   1. History: materials and evolution of construction techniques
   2. Architectural features and styles
   3. Aesthetics: form and function
   4. Material selection: tension, compression, shear, and bending
   5. Structural loads: dead loads, live loads, and environmental loads
   6. Building and Construction Codes
   7. Sustainability practices: Leadership in Energy and Environmental Design certification
   8. Cutting edge design and materials: bridge and structural evolution
   9. Tools: drawings, codes, construction manuals, analysis techniques, and models
   10. Licensing and certification: professional engineers and architects
   11. Ethics: responsibility.

IV. INSTRUCTIONAL TECHNIQUES

A variety of instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Teaching techniques include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction and modeling of procedures
B. Flexible grouping
C. Differentiated tasks
D. Laboratory activities, demonstrations, and experiments that require collection, organization, representation, and analysis of data
E. Problem-based learning
F. Independent practice
G. Integration of technology into class activities
H. Visual models, animations, and video to illustrate or enhance class discussions

I. For strategies to differentiate for special education students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans, please consult the Accommodations and Modifications appendix in the appendices section of this document.

V. EVALUATION

The assessment tools the teacher employs to measure student mastery of course objectives include, but are not limited to, the following:

A. Baseline and benchmark assessments
B. Written tests and quizzes
C. Cumulative tests
D. Homework
E. Independent projects
F. Research papers
G. Presentations
H. Projects
I. Laboratory assignments and participation.

VI. PROFESSIONAL DEVELOPMENT

Opportunities for professional development include:

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

APPENDIX I

Instructional Resources and Pacing Guide

Instructional resource: Various. Instructor provided.

Unit	Approximate number of teaching days
Thermodynamics – Gas Cycles	12 – 14
Thermodynamics – Steam Cycles	12 – 14
Environmental Engineering	10 – 12
Heat Transfer	12 – 14
Fluid Mechanics	12 – 14
Sustainable Energy	12 – 14
Logic and Electrical Engineering	10 – 12
Machine Kinematics	12 – 14
Materials – Stress and Strain	15 – 18
Columns – Stability	12 – 16
Beam Theory	12 – 14
Cables and Arches	12 – 14
Architectural Design – Form and Function	15 – 18

APPENDIX II

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-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-PS2-6. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).
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-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-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.
HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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.
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
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

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 III

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.

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

APPENDIX IV

New Jersey Student Learning Standards for 21st Century Life & Careers

Career Ready Practices
CRP2. Apply appropriate academic and technical skills
CRP4. Communicate clearly and effectively and with reason
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
CRP10. Plan education and career paths aligned to personal goals.
CRP11. Use technology to enhance productivity.

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

APPENDIX V

New Jersey Student Learning Standards for English Language Arts

Progress Indicators for Reading Science and Technical Subjects

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.11-12.3. 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.11-12.8. 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.
WHST.11-12.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

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.11-12.9 Draw evidence from informational texts to support analysis reflection, and research.

The entire standards document can be viewed at http://www.state.nj.us/education/cccs/2016/ela/

APPENDIX VI

New Jersey Student Learning Standards for Mathematical Practice

SMP1 – Make sense of problems and persevere in solving them
SMP2 – Reason abstractly and quantitatively
SMP3 – Construct viable arguments and critique the reasoning of others
SMP4 – Model with mathematics
SMP5 – Use appropriate tools strategically
SMP6 – Attend to precision
SMP7 – Look for and make use of structure
SMP8 – Look for and express regularity in repeated reasoning.

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

APPENDIX VII

Integrated Accommodations and Modifications for Special Education Students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans (N.J.A.C. 6A: 8)

Special Education
ENVIRONMENT
Preferential Seating
Adjust time for completion of assignments when needed
Adjust length of assignments when needed
Allow additional oral response time
Break tasks (including long range assignments) into manageable steps
Provide copies of notes
Reduce the number of problems on a page
Provide assistance with organizing a notebook or folder
Repeat/ clarify directions when needed
Make frequent checks for work/assignment completion.
Modify homework and class work if needed

Extend time on tests/quizzes
Provide study guides for tests
Provide oral component when needed
Modify format when needed- (ex: limit choices, word bank, shortened written responses)
Allow a private workspace when needed (study carrel, separate desk, desk away from the group)
Allow opportunities for movement (e.g., help with supplies, change to different part of room to work, carry messages to office)
Assist the student to keep only the materials required for the lesson on the desktop
Provide a seat away from distractions (or noise)
MATERIAL/BOOKS/EQUIPMENT
Allow use of a calculator
Allow use of a number line
Allow use of counting chips
Modify worksheets
Provide visual aids (pictures, flash cards, etc.)
Provide auditory aids (cues, tapes, etc.)

Use manipulatives
Provide hands-on learning activities
INSTRUCTIONAL STRATEGIES
Check work in progress
Provide immediate feedback
Provide extra drill/practice
Provide review sessions
Provide models
Highlight key words
Provide pictures/charts
Use mnemonics
Support auditory presentations with visuals
Have student restate information
Provide lecture notes/outline
Give oral reminders
Give visual reminders

Review directions
Use graphic organizers
Assign partners
Repeat instructions
Display key vocabulary
Monitor assignments
Provide visual reinforcement
Provide concrete examples
Use vocabulary word bank
ORGANIZATION
Post assignments
Provide a desktop list of tasks
Give one paper at a time
Provide extra space for work
List sequential steps
Provide folders to hold work

Post routines
Use pencil box for tools
Reorganize poorly designed worksheets to create simple, easy-to-follow layouts and formats
Give advance warning when transition is going to take place
Provide structure for success
Provide a contract, timer, etc., for self-monitoring
Give the student a prompt when he/she is off task (e.g., move close to the student, speak to the student, etc.)
TEST/QUIZZES/TIME
Give prior notice of test
Provide oral testing
Provide extra time for written work
Provide modified tests
Rephrase test questions/directions
Preview test procedures
Provide shortened tasks
Provide extra time for tests

Read test to student
Provide test study guides
Limit multiple choice options
Provide extra time for projects
Pace long term projects
Simplify test wording
Provide hands-on projects
Allow extra response time
ENGLISH LANGUAGE LEARNERS
GRADING
Standard Grades vs. Pass/Fail
CONTINUUM OF ENGLISH LANGUAGE DEVELOPMENT
Pre K-K WIDA CAN DO Descriptors
Grades 1-2 WIDA CAN DO Descriptors
Grades 3-5 WIDA CAN DO Descriptors
Grades 6-8 WIDA CAN DO Descriptors
Grades 9-12 WIDA CAN DO Descriptors

SIOP COMPONENTS AND FEATURES
PREPARATION
Write content objectives clearly for students
Write language objectives clearly for students
Choose content concepts appropriate for age and educational background levels of students
Identify supplementary materials to use
Adapt content to all levels of students proficiency
Plan meaningful activities that integrate lesson concepts with language practices opportunities for reading, writing, listening, and/or speaking
BUILDING BACKGROUND
Explicitly link concepts to students' backgrounds and experiences
Explicitly link past learning and new concepts
Emphasize key vocabulary for students
COMPREHENSIBLE INPUT
Use speech appropriate for students' proficiency level
Explain academics tasks clearly
Use a variety of techniques to make content concepts clear (e.g. modeling, visuals, hands-on activities, demonstrations, gestures, body language)
STRATEGIES

Provide ample opportunities for students to use strategies (e.g. problem solving, predicting, organizing, summarizing, categorizing, evaluating, self-monitoring)
Use scaffolding techniques consistently throughout lesson
Use a variety of question types including those that promote higher-order thinking skills throughout the lesson
INTERACTION
Provide frequent opportunities for interaction and discussion between teacher/students and among students about lessons concepts, and encourage elaborated responses
Use group configurations that support language and content objectives of the lesson
Provide sufficient wait time for student responses consistently
Give ample opportunities for students to clarify key concepts in LI as needed with aide, peer, or LI text
PRACTICE/APPLICATION
Provide hands-on materials and/ manipulatives for students to practice using new content knowledge
Provide activities for students to apply content and language knowledge in the classroom
Provide activities that integrate all language skills
LESSON DELIVERY
Support content objectives clearly
Support language objectives clearly
Engage students approximately 90-100% of the period
Pace the lesson appropriately to the students' ability level

REVIEW/EVALUATION
Give a comprehensive review of key vocabulary
Give a comprehensive review of key content concepts
Provide feedback to students regularly on their output
Conduct assessments of students comprehension and learning throughout lesson and all lesson objectives

STUDENTS AT RISK OF SCHOOL FAILURE (I&RS RESOURCE MANUAL)

ACADEMICS
Provide necessary services (Lit Support, Math Support, OT, PT, speech, etc.)
Literacy Support Interventions (Appendix B of IS forms)
Prompt before directions/questions are verbalized with visual cue between teacher and student
Task list laminated and placed on desk for classroom routines and organization
Preferential seating
Provide structure and positive reinforcements
Sustained working time connected to reward (If/Then statement)
Frequently check for understanding
Graphic organizers
Tracker
Slant board

Access to accurate notes
Additional time to complete tasks/long-term projects with adjusted due dates
Limit number of items student is expected to learn at one time
Break down tasks into manageable units
Directions repeated, clarified, or reworded
Frequent breaks during class
Allow verbal rather than written responses
Modify curriculum content based on student's ability level
Reduce readability level of materials
Allow typed rather than handwritten responses
Use of calculator
Use of a math grid
Provide models/organizers to break down independent tasks
Access to electronic text (e.g. Downloaded books)
Provide books on tape, CD, or read aloud computer software
Provide opportunities for using a Chromebook as well as assistive technologies
Provide buddy system
Adjust activity, length of assignment, and/or number of problems, including homework

Provide assessments in a small group setting
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Communication with parents
Gradual release of responsibility related to writing prompts (Proximity, Sentence Starter, Attempt independently)
Rubric-based checklist
Target specific number of details and focus on organization with post-its
Accept late work/homework without penalty
Previewing material (access to PowerPoint slides, novels, syllabus, study guides when available)
SOCIAL/EMOTIONAL
Children's books addressing presenting problem
Student jots down presenting problem and erase when it goes away
Meet with guidance counselor
Student jots down presenting problem and erase when it goes away
Attendance plan
Utilize nurse during episodes of presenting problem
Provide short breaks
Attendance plan
Communication with parents

Assign "jobs" to reduce symptoms
Counseling check-ins
Praise whenever possible
ATTENTION/FOCUS
Seat student near front of room
Preferential seating
Monitor on-task performance
Arrange private signal to cue student to off-task behavior
Establish and maintain eye contact when giving oral directions
Stand in proximity to student to focus attention
Provide short breaks when refocusing is needed
Use study carrel
Arrange physical layout to limit distractions
Frequently ask questions to engage student
Refocusing and redirection
Behavior/time management system
Group directions 1 step at a time
Assign "jobs" to reduce symptoms

Arrange physical layout to limit distractions
Frequently ask questions to engage student
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Extended time on assignments/assessments
Provide assessments in a small group setting
Provide buddy system
Establish and maintain eye contact when giving oral directions
Permit the use of headphones while working
SCHOOL REFUSAL/ELEVATED ABSENTEEISM
Attendance plan
GIFTED AND TALENTED STUDENTS
CURRICULUM
Acceleration
Compacting
Telescoping
Advanced Placement Courses
INSTRUCTION
Grouping

Independent Study
Differentiated Conferencing
Project-Based Learning
Competitions
Cluster Grouping Model with Flexible Grouping
Differentiated Instruction
Summer Work
Parent Communication

WESTFIELD PUBLIC SCHOOLS

Westfield, New Jersey

Office of Instruction

Course of Study

SCIENCE APPLICATIONS

School .....Edison and Roosevelt
Department.....Science
Length of Course.....Semester
Grade Level.....8
Date .....

I. RATIONALE, DESCRIPTION AND PURPOSE

Science Applications is a semester elective course for eighth grade students. Science Applications is designed to provide students with an enrichment experience in science, complementing the skills, content, and practices they have experienced in their intermediate school science courses. Students build upon their existing knowledge of the physical world and apply this knowledge to a series of units that strongly emphasize STEM proficiencies. Students participate in hands-on lab activities and interactive simulations which are observed, described, and interpreted to develop an understanding of the laws of the physical world.

II. OBJECTIVES

The district objectives are aligned with the New Jersey Student Learning Standards for Science, 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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2

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
New Jersey Student Learning Standards for 21st Century Life and Careers CRP11

C. 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 P1,2,3
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.3
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,6,8

D. 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 P4,6,7,8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.7
New Jersey Student Learning Standards for Mathematical Practice SMP4
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,8

E. 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 P4,7,8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.8
New Jersey Student Learning Standards for Mathematical Practice SMP8

F. 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 P2,7,8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects WHST.6-8.1, 6-8.4
New Jersey Student Learning Standards for 21st Century Life and Careers CRP4,8
New Jersey Student Learning Standards for Mathematical Practice SMP3

G. Demonstrate proficiency in the use of laboratory technology including, but not limited to, data collection probe ware, and video analysis software and research microscopes.
New Jersey Student Learning Standards for Science: Science and Engineering Practices P3
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.3
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,11

Science Applications Practices
Students:

A. Develop investigations using kinematics about an object or system's motion to predict and analyze velocity and acceleration properties through mathematical models and graphical representations
New Jersey Student Learning Standards for Science: MS-PS2-2
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-6
New Jersey Student Learning Standards for Mathematical Practice: SMP1,2,4,6
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.3, 6-8.4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,8

B. Develop investigations using dynamics involving Newton's Second Law to determine the relationship between the net force exerted on an object, its mass, and its acceleration
New Jersey Student Learning Standards for Science: MS-PS2-1, MS-PS2-2
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-6
New Jersey Student Learning Standards for Mathematical Practice: SMP1,2,4,5,6
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.3, 6-8.4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,8

C. Develop investigations to analyze the mechanical energies (kinetic, gravitational potential, elastic potential, work) of a system using narrative, mathematical, and graphical representations
New Jersey Student Learning Standards for Science: MS-PS3-1, MS-PS3-2, MSPS3-5
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-6
New Jersey Student Learning Standards for Mathematical Practice: SMP1,2,4,5,6
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.3, 6-8.4
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,6,8

D. Evaluate global climate models to make an evidence-based forecast of climate change and identify relationships among Earth systems and human activity
New Jersey Student Learning Standards for Science: MS-ESS3-5, MS-ESS3-6
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1,2,4,5,6,7,8
New Jersey Student Learning Standards for Mathematical Practice: SMP1,2,4,5,6,7
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.2, 6-8.8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,6,8

E. Investigate the functional components and methods allowing disease to spread through ecosystems and populations
New Jersey Student Learning Standards for Science: MS-LS2-2, MS-LS2-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1,2,4,8
New Jersey Student Learning Standards for Mathematical Practice: SMP2,7
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.2, 6-8.8
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,6,8

F. Apply the Engineering Design Process to create, test, and refine solutions to real-world problems taking into account appropriate criteria and constraints.
New Jersey Student Learning Standards for Science: MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4
New Jersey Student Learning Standards for Science: Science and Engineering Practices P1-8
New Jersey Student Learning Standards for Mathematical Practice: SMP1-8
New Jersey Student Learning Standards for English Language Arts: Science & Technical Subjects RST.6-8.3
New Jersey Student Learning Standards for Educational Technology 8.1
New Jersey Student Learning Standards for 21st Century Life and Careers CRP2,4,6,8

III. CONTENT, SCOPE, AND SEQUENCE

Physics, Biology and Earth Science principles are universal and the course presents real-life applications that relate to all students. Students are provided with many opportunities to engage in hands-on experiments and create models about phenomena in the world around them.
The course emphasizes the connection between conceptual and mathematical thinking that both represent real-life physics phenomenon. The content, opportunity for student inquiry, applied mathematics, modeling and conceptual reasoning are all important to Physics, Biology and Earth

Science. The objectives previously listed and the content, scope, and sequence to follow, will provide students with the opportunity to engage in these science practices.

A. Orthographic Drawing
    1. Three dimensional rendering
    2. Relative sizing
    3. Visualization techniques
    4. Comparison to other drawing formats
    5. Revision process

B. Rockets
    1. Newtonian Motion
    2. Mass fraction
    3. Aerodynamics
    4. Rocket equation
    5. Payload
    6. Thrust ratios

C. Bridges
    1. Efficiency
    2. Adhesive performance
    3. Forces on structures
    4. Engineering failures
    5. Deflection
    6. Elastic limit
    7. Bending

D. Epidemiology and disease outbreaks
    1. Epidemiology
    2. Bacteria and viruses
    3. Outbreak responses

E. Roller Coasters
    1. Kinetic Energy
    2. Potential Energy
    3. Friction

F. Scrambler
    1. Simple machines
    2. Gravitational Potential Energy
    3. Wheelbase
    4. Use of bearings
    5. Tracking
    6. Elastic Potential Energy

G. Catapults
    1. Simple machines
    2. Torsion
    3. Projectile motion
    4. Relation of angle and distance

H. Coping with the challenges of the rate of Climate Change
    1. Climate modeling
    2. Sustainability
    3. Preventing loss
    4. Solutions to the climate challenge.

IV. INSTRUCTIONAL TECHNIQUES

A variety of instructional approaches are employed to engage all students in the learning process and accommodate differences in readiness levels, interests and learning styles. Teaching techniques include, but are not limited to, the following:

A. Teacher-directed, whole-group instruction and modeling of procedures
B. Flexible grouping
C. Differentiated tasks
D. Laboratory activities, demonstrations, and experiments that require collection, organization, representation, and analysis of data
E. Problem-based learning
F. Independent practice
G. Integration of technology into class activities
H. Visual models, animations, and video to illustrate or enhance class discussions.
I. Class consensus model building
J. For strategies to differentiate for special education students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans, please consult the Accommodations and Modifications appendix in the appendices section of this document.

V. EVALUATION

The assessment tools the teacher employs to measure student mastery of course objectives include, but are not limited to, the following:

A. Baseline and benchmark assessments
B. Written tests and quizzes
C. Cumulative tests
D. Homework
E. Independent projects
F. Research papers
G. Presentations
H. Laboratory assignments and participation
I. Project performance against known standards.

VI. PROFESSIONAL DEVELOPMENT

Opportunities for professional development include:

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

APPENDIX I

Pacing Guide

Unit	Approximate number of teaching days
Orthographic Drawing	5
Rockets	15
Bridges	15
Disease Detectives	5
Roller Coasters	12
Scramblers	15
Catapults	15
Climate Change	8
	90 days total

APPENDIX II

New Jersey Student Learning Standards for Science

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.
MS-PS2-2. Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
MS-ESS3-5. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
MS-ESS3-6. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.
MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

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

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 III

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.

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

APPENDIX IV

New Jersey Student Learning Standards for 21st Century Life & Careers

Career Ready Practices
CRP2. Apply appropriate academic and technical skills
CRP4. Communicate clearly and effectively and with reason
CRP6. Demonstrate creativity and innovation
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them
CRP11. Use technology to enhance productivity.

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

APPENDIX V

New Jersey Student Learning Standards for English Language Arts

RST.6-8.2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
RST.6-8.4. 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 6-8 texts and topics.
RST.6-8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
RST.6-8.8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
WHST.6-8.1. Write arguments focused on discipline-specific content.

WHST.6-8.4. Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.

The entire standards document can be viewed at http://www.state.nj.us/education/cccs/2016/ela/

APPENDIX VI

New Jersey Student Learning Standards for Mathematical Practice

SMP1 – Make sense of problems and persevere in solving them
SMP2 – Reason abstractly and quantitatively
SMP3 – Construct viable arguments and critique the reasoning of others
SMP4 – Model with mathematics
SMP5 – Use appropriate tools strategically
SMP6 – Attend to precision
SMP7 – Look for and make use of structure
SMP8 – Look for and express regularity in repeated reasoning.

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

APPENDIX VII

Integrated Accommodations and Modifications for Special Education Students, English Language Learners, Students at Risk of School Failure, Gifted and Talented Students, and Students with 504 Plans (N.J.A.C. 6A: 8)

Special Education
ENVIRONMENT
Preferential Seating
Adjust time for completion of assignments when needed
Adjust length of assignments when needed
Allow additional oral response time
Break tasks (including long range assignments) into manageable steps

Provide copies of notes
Reduce the number of problems on a page
Provide assistance with organizing a notebook or folder
Repeat/ clarify directions when needed
Make frequent checks for work/assignment completion.
Modify homework and class work if needed
Extend time on tests/quizzes
Provide study guides for tests
Provide oral component when needed
Modify format when needed- (ex: limit choices, word bank, shortened written responses)
Allow a private workspace when needed (study carrel, separate desk, desk away from the group)
Allow opportunities for movement (e.g., help with supplies, change to different part of room to work, carry messages to office)
Assist the student to keep only the materials required for the lesson on the desktop
Provide a seat away from distractions (or noise)
MATERIAL/BOOKS/EQUIPMENT

Allow use of a calculator
Allow use of a number line
Allow use of counting chips
Modify worksheets
Provide visual aids (pictures, flash cards, etc.)
Provide auditory aids (cues, tapes, etc.)
Use manipulatives
Provide hands-on learning activities
INSTRUCTIONAL STRATEGIES
Check work in progress
Provide immediate feedback
Provide extra drill/practice
Provide review sessions
Provide models
Highlight key words
Provide pictures/charts

Use mnemonics
Support auditory presentations with visuals
Have student restate information
Provide lecture notes/outline
Give oral reminders
Give visual reminders
Review directions
Use graphic organizers
Assign partners
Repeat instructions
Display key vocabulary
Monitor assignments
Provide visual reinforcement
Provide concrete examples
Use vocabulary word bank
ORGANIZATION

Post assignments
Provide a desktop list of tasks
Give one paper at a time
Provide extra space for work
List sequential steps
Provide folders to hold work
Post routines
Use pencil box for tools
Reorganize poorly designed worksheets to create simple, easy-to-follow layouts and formats
Give advance warning when transition is going to take place
Provide structure for success
Provide a contract, timer, etc., for self-monitoring
Give the student a prompt when he/she is off task (e.g., move close to the student, speak to the student, etc.)
TEST/QUIZZES/TIME
Give prior notice of test
Provide oral testing

Provide extra time for written work
Provide modified tests
Rephrase test questions/directions
Preview test procedures
Provide shortened tasks
Provide extra time for tests
Read test to student
Provide test study guides
Limit multiple choice options
Provide extra time for projects
Pace long term projects
Simplify test wording
Provide hands-on projects
Allow extra response time
ENGLISH LANGUAGE LEARNERS
GRADING
Standard Grades vs. Pass/Fail

CONTINUUM OF ENGLISH LANGUAGE DEVELOPMENT
Pre K-K WIDA CAN DO Descriptors
Grades 1-2 WIDA CAN DO Descriptors
Grades 3-5 WIDA CAN DO Descriptors
Grades 6-8 WIDA CAN DO Descriptors
Grades 9-12 WIDA CAN DO Descriptors
SIOP COMPONENTS AND FEATURES
PREPARATION
Write content objectives clearly for students
Write language objectives clearly for students
Choose content concepts appropriate for age and educational background levels of students
Identify supplementary materials to use
Adapt content to all levels of students proficiency
Plan meaningful activities that integrate lesson concepts with language practices opportunities for reading, writing, listening, and/or speaking
BUILDING BACKGROUND
Explicitly link concepts to students' backgrounds and experiences
Explicitly link past learning and new concepts
Emphasize key vocabulary for students

COMPREHENSIBLE INPUT
Use speech appropriate for students' proficiency level
Explain academics tasks clearly
Use a variety of techniques to make content concepts clear (e.g. modeling, visuals, hands-on activities, demonstrations, gestures, body language)
STRATEGIES
Provide ample opportunities for students to use strategies (e.g. problem solving, predicting, organizing, summarizing, categorizing, evaluating, self-monitoring)
Use scaffolding techniques consistently throughout lesson
Use a variety of question types including those that promote higher-order thinking skills throughout the lesson
INTERACTION
Provide frequent opportunities for interaction and discussion between teacher/students and among students about lessons concepts, and encourage elaborated responses
Use group configurations that support language and content objectives of the lesson
Provide sufficient wait time for student responses consistently
Give ample opportunities for students to clarify key concepts in LI as needed with aide, peer, or LI text
PRACTICE/APPLICATION
Provide hands-on materials and/ manipulatives for students to practice using new content knowledge
Provide activities for students to apply content and language knowledge in the classroom
Provide activities that integrate all language skills

LESSON DELIVERY
Support content objectives clearly
Support language objectives clearly
Engage students approximately 90-100% of the period
Pace the lesson appropriately to the students' ability level
REVIEW/EVALUATION
Give a comprehensive review of key vocabulary
Give a comprehensive review of key content concepts
Provide feedback to students regularly on their output
Conduct assessments of students comprehension and learning throughout lesson and all lesson objectives
STUDENTS AT RISK OF SCHOOL FAILURE (I&RS RESOURCE MANUAL)
ACADEMICS
Provide necessary services (Lit Support, Math Support, OT, PT, speech, etc.)
Literacy Support Interventions (Appendix B of IS forms)
Prompt before directions/questions are verbalized with visual cue between teacher and student
Task list laminated and placed on desk for classroom routines and organization
Preferential seating
Provide structure and positive reinforcements

Sustained working time connected to reward (If/Then statement)
Frequently check for understanding
Graphic organizers
Tracker
Slant board
Access to accurate notes
Additional time to complete tasks/long-term projects with adjusted due dates
Limit number of items student is expected to learn at one time
Break down tasks into manageable units
Directions repeated, clarified, or reworded
Frequent breaks during class
Allow verbal rather than written responses
Modify curriculum content based on student's ability level
Reduce readability level of materials
Allow typed rather than handwritten responses
Use of calculator
Use of a math grid
Provide models/organizers to break down independent tasks

Access to electronic text (e.g. Downloaded books)
Provide books on tape, CD, or read aloud computer software
Provide opportunities for using a Chromebook as well as assistive technologies
Provide buddy system
Adjust activity, length of assignment, and/or number of problems, including homework
Provide assessments in a small group setting
Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Communication with parents
Gradual release of responsibility related to writing prompts (Proximity, Sentence Starter, Attempt independently)
Rubric-based checklist
Target specific number of details and focus on organization with post-its
Accept late work/homework without penalty
Previewing material (access to PowerPoint slides, novels, syllabus, study guides when available)
SOCIAL/EMOTIONAL
Children's books addressing presenting problem
Student jots down presenting problem and erase when it goes away
Meet with guidance counselor
Student jots down presenting problem and erase when it goes away

Attendance plan
Utilize nurse during episodes of presenting problem
Provide short breaks
Attendance plan
Communication with parents
Assign "jobs" to reduce symptoms
Counseling check-ins
Praise whenever possible
ATTENTION/FOCUS
Seat student near front of room
Preferential seating
Monitor on-task performance
Arrange private signal to cue student to off-task behavior
Establish and maintain eye contact when giving oral directions
Stand in proximity to student to focus attention
Provide short breaks when refocusing is needed
Use study carrel
Arrange physical layout to limit distractions

Frequently ask questions to engage student
Refocusing and redirection
Behavior/time management system
Group directions 1 step at a time
Assign "jobs" to reduce symptoms
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Educate/train relevant staff with regards to the signs/symptoms, promote tolerance of needs, and/or providing assistance
Extended time on assignments/assessments
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SCHOOL REFUSAL/ELEVATED ABSENTEEISM
Attendance plan
GIFTED AND TALENTED STUDENTS
CURRICULUM
Acceleration

Compacting
Telescoping
Advanced Placement Courses
INSTRUCTION
Grouping
Independent Study
Differentiated Conferencing
Project-Based Learning
Competitions
Cluster Grouping Model with Flexible Grouping
Differentiated Instruction
Summer Work
Parent Communication