Fair Lawn

Public Schools

Fair Lawn, NJ

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Science

Grade 8 / 8E

2016

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Middle School science is a integrated, spiraled science program developed by a committee of Fair Lawn middle school science teachers. It is aligned to the NJSLS-S which are correlated to the NJSLS-ELA and NJSLS-M. There is a focus on learning science through investigation and through reading non-fiction texts and inquiry-based science exploration.

Science Department

Fair Lawn School District

Committee Credits

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I. Course Synopsis

Our middle school science program reflects and integrated, thematic approach to the study of the field of science which supports the philosophy of the NJSLS-S. Students will develop an understanding of the core principals of physical, earth, space, and life science while engaging in engineering and technology through exposure to rich, non-fiction text and a rich application of mathematical skills through data analysis and problem solving.

II. Philosophy & Rationale

This course has been aligned to and developed with the NJSLS-S as its focus.

All NJSLS-S aligned courses in the Fair Lawn Schools demonstrate a commitment preparing students to become college and career ready as well as the other guiding assumptions of the Frameworks for Science Education (NRC, 2011) and the NJSLS-S including

- Students are born investigators;
- Science instruction should focus on core ideas and practices;
- An understanding of science develops over time;
- Science and engineering require both knowledge and practice;
- Science education must connect to students' interests and experiences; and
- Promoting equity for all students must be a focus of science education.

Additionally, all NJSLS-S aligned courses in the Fair Law Schools integrate the three dimensions discussed in the Frameworks for Science Education and the NJSLS-S, including

- Science & Engineering Practices which describe behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems; (NGSS PDF)
- Cross Cutting Concepts which link all domains of science and provide an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world; (NGSS PDF) and
- Disciplinary Core Ideas which focus and unite K-12 science, have a broad importance across multiple sciences or engineering disciplines or are a key organizing concept within a single discipline; provide a key tool for understanding or investigating more complex ideas and solving problems; relate to the interests and life experiences of students; are connected to societal or personal concerns that require scientific or technological knowledge; and are teachable and learnable over multiple grades at increasing depth and sophistication. (NGSS PDF)

Since coherence is a main dimension of the NJSLS-S, consider reviewing the "story line" for the middle school physical science, life science, earth and space science, and engineering, technology and applications of science, as well as the high school physical science, life science, earth and space science, and engineering, technology and application of science for a full picture of the NJSLS-S philosophy. For a full picture of how these programs are implemented in the Fair Lawn Schools, visit the district curriculum website.

As described in the NJSLS-S, technical writing and reading non-fiction is also a focus of our elementary science curricula as required by the NJSLS-ELA and Math. Students are expected to think critically about data they collect or read about and then express their thoughts through text-based narratives, journal entries, short-constructed response, argument-based writing, and/or in-class discussion.

Differentiated instruction for students at different levels of achievement and specific learning needs (e.g. special education, English Language Learners (ELL), at-risk, and Gifted & Talented) is embedded in targeted scaffolding based on knowledge of each student's interests, needs, and assessment data, including, but not limited to, in class formative and summative assessments.

When deemed appropriate, department teachers will engage students in purposeful paired discussions to share information more effectively, such as the "turn and talk" (Harvey & Daniels, 2009). "Text annotation" could be used, for example to optimize reading comprehension (Daniels & Steineke, 2010).

III. Scope & Sequence

The Grade 8 Science program consists of thematic units reflective of the NJSLS-S. Each unit develops new content with consistent emphasis on the science and engineering processes, disciplinary core ideas, and cross cutting concepts reflective of the Next Generation Science Standards and the Frameworks for Science Education.

Enriched grade 8 science follows the same sequence as college prep grade 8 science and the objectives are the same. Students in enriched science will be expected to:

- Address some content in greater depth;
- Apply additional pre-algebra/algebra calculations and analysis to some content;
- Engage in additional independent work;
- Apply literacy analytical skills at a higher lexile level and/or read secondary scientific literature from journals such as Scientific American, Popular Science, and/or the New York Times;
- Complete their studies at a quicker pace than college prep science.

Specific examples are listed in the curriculum.

Grade 6	Grade 7	Grade 8
Intro to MS Science *2 Weeks*	**Chemistry of Materials** *7 Weeks*	**Energy** *8 Weeks*
Waves *6 Weeks*	**Water** *8 Weeks*	**Force & Motion** *8 Weeks*
Ecology *8 Weeks*	**Erosion & Deposition** *8 Weeks*	**Plate Tectonics** *6 Weeks*
Cell Biology *8 Weeks*	**Genetics*** *6 Weeks*	**Evolution** *5 Weeks* **May be interrupted by last unit.*
Weather & Atmosphere *8 Weeks*	**Space**** *6 Weeks*	**Review of MS Science** *2 Weeks*

*Note: Due to the sequence change, "Genetics" will be replaced with "Waves" during the 2016-2017 school year

**Efforts will be made to include a field trip to the FLHS Planetarium.

Unit 1: Energy

Enduring Understanding:

1. Energy is not created or destroyed. It changes form.
2. Energy efficiency can lead to a more sustainable society.

Essential Questions:

1. How can an understanding of energy transfer provide for a sustainable society?

Learning Objectives:
Based on the MS Evidence Statements

MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces. [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] [Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]

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. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.]

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. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate's hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] [Assessment Boundary: Assessment is limited to two objects and electric, magnetic, and gravitational interactions.]

MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.* [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

MS-PS3-4. Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample. [Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] [Assessment Boundary: Assessment does not include calculating the total amount of thermal energy transferred.]

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. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]

MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

- **ELL/Special Education Students:**
  - Provide ELL students with short lists of essential academic vocabulary terms to assist with language development such as word walls;
  - Provide ELL students with opportunities for peer to peer interactions;
  - Explicitly teach ELL students academic language and link to main ideas;
  - Support ELL students through the use of graphic organizers, modeling, and visual aides.

- Support special education students through the use of physical activity, modeling, role-play, dialogue, reading assignments based on ability, etc.

- **Gifted Students**
  - Provide students with supplemental enrichment activities which afford them an opportunity to independently enhance their understanding of the science and engineering practices, such as through experimental design or the analysis of science research.
  - Students in enriched science will be expected to perform calculations related to energy transfer.

Cross-Content Connections:

NJSLS- Math: Students will make observations, measure, collect data, and interpret data related to energy.

NJSLS-Literacy: Students will analyze text.

8.1: Use technology to collect and analyze data and to communicate findings with local peers and peers from other classes.

9.2: Explore careers directly related to this unit.

Unit 2: Force & Motion

Enduring Understanding:

1. For every action, there is an equal and opposite reaction.

Essential Questions:

1. How can an understanding of the relationships between forces help to make human technology safer?

Learning Objectives:
Based on the MS Evidence Statements

MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.* [Clarification Statement: Examples of practical problems could include the impact of collisions between two cars, between a car and stationary objects, and between a meteor and a space vehicle.] [Assessment Boundary: Assessment is limited to vertical or horizontal interactions in one dimension.]

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. [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] [Assessment Boundary: Assessment is limited to forces and changes in motion in one-dimension in an inertial reference frame and to change in one variable at a time. Assessment does not include the use of trigonometry.]

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

See unit 1 for suggestions to meet needs of diverse learners.

Students in enriched science may study Newton's Law of gravitation and may apply additional calculations related to forces.

Cross-Content Connections:

NJSLS- Math: Students will make observations, measure, collect data, and interpret data related to data collection and force.
NJSLS-Literacy: Students will read, write, and analyze text, related to the science content.

8.1: Use technology to collect and analyze data and to communicate findings with local peers and peers from other classes. **9.2:** Explore careers directly related to this unit.

9.2: Explore careers directly related to this unit.

Unit 3: Plate Tectonics

Enduring Understanding:

1. The plates which make up the layers of the Earth are continually in motion.

Essential Questions:

1. How can an understanding of the motion of the plates be used by geologists to maintain a safe environment?

Learning Objectives:
Based on the MS Evidence Statements

MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history. [Clarification Statement: Emphasis is on how analyses of rock formations and the fossils they contain are used to establish relative ages of major events in Earth's history. Examples of Earth's major events could range from being very recent (such as the last Ice Age or the earliest fossils of homo sapiens) to very old (such as the formation of Earth or the earliest evidence of life). Examples can include the formation of mountain chains and ocean basins, the evolution or extinction of particular living organisms, or significant volcanic eruptions.] [Assessment Boundary: Assessment does not include recalling the names of specific periods or epochs and events within them.]

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.]

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth's surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.]

MS-ESS2-3. Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions. [Clarification Statement: Examples of data include similarities of rock and fossil types on different continents, the shapes of the continents (including continental shelves), and the locations of ocean structures (such as ridges, fracture zones, and trenches).] [Assessment Boundary: Paleomagnetic anomalies in oceanic and continental crust are not assessed.]

MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. [Clarification Statement: Emphasis is on how some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable predictions, but others, such as earthquakes, occur suddenly and with no notice, and thus are not yet predictable. Examples of natural hazards can be taken from interior processes (such as earthquakes and volcanic eruptions), surface processes (such as mass wasting and tsunamis), or severe weather events (such as hurricanes, tornadoes, and floods). Examples of data can include the locations, magnitudes, and frequencies of the natural hazards. Examples of technologies can be global (such as satellite systems to monitor hurricanes or forest fires) or local (such as building basements in tornadoprone regions or reservoirs to mitigate droughts).]

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

See unit 1 for suggestions to meet needs of diverse learners.

Students in enriched science may complete independent research related to actual historical events related to the motion of the plates.

Cross-Content Connections:

NJSLS- Math: Students will make observations, measure, collect data, and interpret data related to data collection relate to plate motion.

NJSLS-Literacy: Students will read, write, and analyze text, related to the science content.

8.1: Use technology to collect and analyze data and to communicate findings with local peers and peers from other classes. **9.2:** Explore careers directly related to this unit.

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Unit 4: Evolution

Enduring Understanding:

1. The environment selects the organisms with the traits most suited to survive and reproduce.

Essential Questions:

1. How do environmental factors select the organisms with the best traits?
2. How could bringing back an extinct species affect the balance of nature which currently exists?

Learning Objectives:
Based on the MS Evidence Statements

MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, creating conditions for seed germination and growth. Examples of plant structures could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.]

MS-LS4-1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past. [Clarification Statement: Emphasis is on finding patterns of changes in the level of complexity of anatomical structures in organisms and the chronological order of fossil appearance in the rock layers.] [Assessment Boundary: Assessment does not include the names of individual species or geological eras in the fossil record.]

MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships. [Clarification Statement: Emphasis is on explanations of the evolutionary relationships among organisms in terms of similarity or differences of the gross appearance of anatomical structures.]

MS-LS4-3. Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy. [Clarification Statement: Emphasis is on inferring general patterns of relatedness among embryos of different organisms by comparing the macroscopic appearance of diagrams or pictures.] [Assessment

Boundary: Assessment of comparisons is limited to gross appearance of anatomical structures in embryological development.]

MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]

MS-LS4-5. Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. [Clarification Statement: Emphasis is on synthesizing information from reliable sources about the influence of humans on genetic outcomes in artificial selection (such as genetic modification, animal husbandry, gene therapy); and, on the impacts these technologies have on society as well as the technologies leading to these scientific discoveries.]

MS-LS4-6. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. [Clarification Statement: Emphasis is on using mathematical models, probability statements, and proportional reasoning to support explanations of trends in changes to populations over time.] [Assessment Boundary: Assessment does not include Hardy Weinberg calculations.]

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

See unit 1 for suggestions to meet needs of diverse learners.

Students in enriched science may relate the study of genetics to the study of population changes and perform algebraic calculations to model such changes (Hardy Weinberg).

Cross-Content Connections:

NJSLS- Math: Students will make observations, measure, collect data, and interpret data related to proportional reasoning.

NJSLS-Literacy: Students will read, write, and analyze text, related to the science content.

8.1: Use technology to collect and analyze data and to communicate findings with local peers and peers from other classes. **9.2:** Explore careers directly related to this unit.

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Unit 5: Review of Middle School Science

Enduring Understanding:

1. The process of science requires an understanding of science and engineering practices.
2. The study of science includes over-arching disciplinary core ideas.
3. The study of science includes basic cross-cutting concepts.

Essential Questions:

1. How do we apply science and engineering practices?
2. How are the cross-cutting concepts related to the disciplinary core ideas we have studied for the past three years?

Learning Objectives:

Students will spend about two weeks review objectives from the previous units from a whole to part perspective.

Learning Objectives:

Based on the MS Evidence Statements

Suggested Activities & Suggested Modifications for Special Education Students, ELL Students, Students at Risk, and Gifted Students:

See unit 1 for suggestions to meet needs of diverse learners.

Cross-Content Connections:

NJSLS- Math: Students will make observations, measure, collect data, and interpret data related to content which they have studied since grade 6.

NJSLS-Literacy: Students will read, write, and analyze text, related to the science content.

8.1: Use technology to collect and analyze data and to communicate findings with local peers and peers from other classes. **9.2:** Explore careers directly related to this unit.

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V. Course Materials

SEPUP/LAB-AIDS is a curriculum resource which provides each classroom with a variety of reading books, a teacher's guide, and inquiry supplies, which should be used along with this curriculum. A pacing guide is provided to teachers on the Google Share Drive. The scope of our curriculum encourages teachers to enrich the SEPUP/LAB-AIDS program with technology tools, for example, and not all activities in the SEPUP/LAB-AIDS program will be completed.

VI. Assessments

Assessment of student learning in science at the elementary level should be formative in nature. Rubrics are provided in the Knowing Science program. The focus of assessment should be of students mastery of the Science and Engineering Processes of the NJSLS-S. The teacher should keep in mind the expected progression of their understandings.

VII. Interdisciplinary Connections and Alignment to Technology standards

By the nature of the SEPUP/Lab-Aids program, students are consistently being asked to address engineering design challenges, which addresses the following standards, throughout the middle school curriculum.

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.**

(http://www.state.nj.us/education/cccs/standards/8/); Workplace readiness standards (http://www.state.nj.us/education/archive/frameworks/ccwr/appendixb.pdf); and 21st Century Content Standards (http://www.state.nj.us/education/cccs/standards/9/#91):

English/Social Studies

Based on English and Social Studies Department collaboration, the following topics have been identified across the American Literature and US History II curricula:

- Civil Rights
- Class Separation/Division
- Education System
- Poor/Wealthy
- Gates/Koch Brothers
- Ferguson

In turn, integrated curriculum has been created based on the essential question:

- How is our American culture shaped by socioeconomic class distinction?

English/Media Arts

Students choose books for independent reading projects in collaboration with the high school media specialist.

Technology-based process supports the construction of the MLA-research paper. This includes a media-driven lesson on acceptable academic sources and computer-based production of a formal research paper.

For alignment to Technology standards (http://www.state.nj.us/education/cccs/standards/8/); Workplace readiness standards (http://www.state.nj.us/education/archive/frameworks/ccwr/appendixb.pdf); and 21st Century Content Standards (http://www.state.nj.us/education/cccs/standards/9/#91),