**Middle School Science Performance Standards**

**Saint John School, 2016-2017**

Note: Annotations refer to appropriate NGSS performance expectations, science and engineering practices, or core disciplinary ideas.

MS-PS: middle school physical science performance expectation

MS-LS: middle school life science performance expectation

MS-ESS: middle school earth and space science performance expectation

MS-ETS: middle school engineering design performance expectation

sp: science and engineering practice

**6th Grade:**

**Scientific Processes:**

1. Make measurements using metric units (sp-4)
2. Convert metric measurements (sp-5)
3. Use standard measuring tools safely (beakers, graduated cylinders, beam balances, etc.) (sp-3)
4. Define the nature of science and scientific models (sp-1, sp-2, sp-6)
5. Describe steps of the scientific method (sp-1, sp-3)
6. Write hypotheses supported by current or previous observations (sp-2, sp-3)
7. Describe types of observations (qualitative, quantitative) (sp-1, sp-3)
8. Make inferences supported by evidence (sp-6, sp-7)
9. Identify types of variables in a scientific investigation (sp-3)
10. Design and carry out a scientific investigation (sp-3)
11. Describe (in essay form) the outcomes and real-world implications of scientific investigations (sp-7, sp-8, MS-ESS3-4)

**Classification of Organisms:**

1. Identify and describe characteristics of living things (MS-LS1-1)
2. Describe the difference between sexual and asexual reproduction (i.e., asexual reproduction results in offspring identical to the parent) (MS-LS1-2, MS-LS1-5)
3. Identify and describe needs of living things (MS-LS1-1, MS-LS1-5)
4. Identify criteria used to classify organisms by most biologists (sp-8)
5. Identify six kingdoms of organisms; identify and describe general characteristics of organisms in each kingdom (sp-8)
6. Identify sub-groups with kingdoms (sp-8)
7. Classify a given organism based on its behavior and physical characteristics (MS-LS1-3)

**Microbiology:**

1. Define and give examples of microorganisms (MS-LS1-1)
2. Model the structure of viruses (MS-LS1-1)
3. Describe how viruses reproduce (MS-LS1-2)
4. Demonstrate that viruses are not usually considered to be living things (MS-LS1-3)
5. Model the structure of bacteria (MS-LS1-1)
6. Design and carry out a scientific investigation that determines conditions favorable to bacterial growth and reproduction (MS-LS1-5)
7. Identify ways that bacteria are helpful and/or harmful to humans (MS-LS1-4, MS-LS1-5)
8. Demonstrate, using evidence, the importance of bacteria to other life on Earth (MS-LS1-5)
9. Describe the characteristics of Protista (MS-LS1-3)
10. Identify & describe features of common species of Protista (amoeba, paramecium, euglena) (MS-LS1-3)
11. Describe behavior of Protista based on observation (MS-LS1-4)
12. Describe causes and effects of algal blooms (MS-LS1-3)
13. Identify & describe characteristics of fungi (MS-LS1-3)
14. Identify & describe common types of fungi (MS-LS1-3)
15. Design and carry out a scientific investigation which demonstrates fungi’s role as a decomposer

(MS-LS1-4)

1. Identify uses and dangers of fungi to humans (MS-LS1-5)

**Earth Science:**

1. Identify & describe the layers of Earth’s interior (MS-ESS2-1)
2. Demonstrate, using evidence, the cause of Earth’s magnetic field (MS-ESS2-1)
3. Identify types of rock in Earth’s lithosphere (MS-ESS2-2)
4. Develop a model to describe the cycling of Earth’s materials and the flow of energy that drives this process (MS-ESS2-1)
5. Describe the theory of plate tectonics (MS-ESS2-1)
6. Construct an explanation based on evidence for how plate tectonic processes have changed Earth’s surface features over geologic time scales (MS-ESS2-2, MS-ESS2-3)
7. Describe the role of convection currents in Earth’s mantle in geological processes on Earth’s surface (MS-ESS2-1)
8. Model the process of sea floor spreading (MS-ESS2-3)
9. Give observational evidence for the theory of plate tectonics (MS-ESS2-3)
10. Identify where earthquakes are most likely to occur (MS-ESS2-2)
11. Use the theory of plate tectonics to make inferences about causes of earthquakes (MS-ESS2-2)
12. Describe consequences of earthquakes (MS-ESS2-2)
13. Identify & describe design features that make human-made structures more resistant to earthquake damage (MS-ESS3-2, MS-ETS1-3)
14. Describe how earthquake intensity is measured (MS-ESS3-2)
15. Describe how volcanoes form (MS-ESS2-1)
16. Identify and describe volcanic landforms (MS-ESS2-2)
17. Describe short-term and long-term consequences of volcanic eruptions (MS-ESS2-2)
18. Model volcanic landform creation (MS-ESS2-2)
19. Analyze and interpret data used to forecast future catastrophic events (i.e, earthquakes and volcanoes) (MS-ESS3-3)
20. Identify major types of rocks; describe how each type is formed (MS-ESS2-2)
21. Identify rock types based on their characteristics (i.e., by using a taxonomic guide) (MS-ESS2-3)
22. Model the creation of fossils (MS-LS4-1)

**Environmental Science:**

1. Define what an ecosystem is (MS-LS2-2)
2. Identify and describe elements of an ecosystem (MS-LS2-2)
3. Define/differentiate ecosystem, community and population (MS-LS2-2)
4. Differentiate between biotic and abiotic elements of an ecosystem (MS-LS2-4)
5. Analyze and interpret data to provide evidence for the effects of resource availability on populations of organisms in an ecosystem (MS-LS2-1)
6. Develop a model that demonstrates how energy moves through an ecosystem (MS-LS2-5)
7. Use food chains and food webs to describe interactions between elements of an ecosystem MS-LS2-3)
8. Model the water, carbon, and nitrogen cycles in ecosystems (MS-LS2-3)
9. Describe how population changes in one species within an ecosystem can effect changes in other populations (MS-LS2-2)
10. Describe how changes in abiotic elements within an ecosystem can effect changes among biotic elements within that system (MS-LS2-4)
11. Describe the process of succession within a given ecosystem (MS-LS2-4)
12. Identify and describe major biomes of the Earth (MS-LS2-4)
13. Describe specific interactions between biotic and abiotic elements with a given biome (MS-LS2-4)
14. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems (MS-LS2-3)
15. Describe consequences of human activity within specific ecosystems (MS-LS2-4)
16. Identify & describe land use patterns of human societies (MS-2-3)
17. Describe major renewable and non-renewable resources important to humans; using evidence, describe how resource-use choices can affect ecosystems (MS-LS2-4)
18. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s natural systems (MS-LS2-5)
19. Identify & describe major environmental challenges facing human societies; using evidence, propose solutions to these challenges, and evaluate competing solutions (MS-LS2-5)
20. Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact natural systems(MS-ESS3-4)

**7th Grade:**

**Scientific Processes:**

1. 1. Make measurements using metric units (sp-4)
2. Convert metric measurements (sp-5)
3. Use standard measuring tools safely (beakers, graduated cylinders, beam balances, etc.) (sp-3)
4. Define the nature of science and scientific models (sp-1, sp-2, sp-6)
5. Describe steps of the scientific method (sp-1, sp-3)
6. Write hypotheses supported by current or previous observations (sp-2, sp-3)
7. Describe types of observations (qualitative, quantitative) (sp-1, sp-3)
8. Make inferences supported by evidence (sp-6, sp-7)
9. Identify types of variables in a scientific investigation (sp-3)
10. Conduct background research and support findings in a coherent essay containing citations (sp-7, sp-8)
11. Design and carry out a scientific investigation (sp-3)
12. Describe (in essay form) the outcomes and real-world implications of scientific investigations (sp-7, sp-8, MS-ESS3-4)

**Motion & Forces:**

1. Define motion (MS-PS2-2)
2. Differentiate between speed, velocity and acceleration (MS-PS2-1, MS-PS2-2, MS-PS2-3)
3. Read and interpret graphs of speed, velocity and acceleration (MS-PS2-1, MS-PS2-2)
4. Identify and describe Newton’s laws of motion (MS-PS2-2)
5. Describe the motion of objects in terms of Newton’s laws of motion (MS-PS2-2)
6. Describe the (classical) universal law of gravitation (MS-PS2-4)
7. Use mathematical formulae to quantitatively describe the motion of objects (sp-2, sp-4)
8. Describe momentum and force (and differentiate between the two) (MS-PS2-2)
9. Identify types of forces (e.g. mechanical, buoyant, electrostatic, etc.) (MS-PS2-5, MS-PS3-2)
10. Predict, measure and interpret the effects of force and momentum on moving objects (MS-PS2-4)
11. Apply Newton’s 3rd Law to design a solution to a problem involving the motion of two colliding objects (MS-PS2-1, MS-PS3-2)
12. Construct and present arguments using evidence to support the claim that gravitational interactions depend on objects’ mass and the distance between them (MS-PS2-4)
13. Design and carry out a scientific investigation that demonstrates the effects of gravitational acceleration on objects (MS-PS2-4)
14. Differentiate between potential and kinetic energy (MS-PS3-5)
15. Construct and interpret graphical displays of data which describe the relationships of kinetic energy to the mass & speed of moving objects (MS-PS3-5)
16. Relate the position of an object/system to the amount of potential energy it contains (MS-PS-2, MS-PS3-4)
17. Construct, use and present arguments to demonstrate that when kinetic energy changes, energy is transferred to or from objects (MS-PS3-5)

**Work, Simple Machines & Engineering Principles:**

1. Define work in the scientific sense (MS-PS3-4)
2. Calculate the work done on objects; use the amount of work done to infer the amount of energy that exists in a system (MS-PS3-4)
3. Differentiate between work and power (MS-PS3-4)
4. Calculate the amount of power used by an object or in a system (MS-PS3-2)
5. Define what simple machines are; differentiate between simple and compound machines (MS-PS2-2)
6. Identify and describe types of simple machines; identify examples of simple machines in everyday life (MS-PS2-2)
7. Calculate mechanical advantage of simple machines (MS-PS3-1)
8. Calculate efficiency of simple machines (MS-PS3-1)
9. Design and carry out a scientific investigation to determine the mechanical advantage and efficiency of common simple machines (MS-PS3-1, MS-PS3-5)
10. Design and construct a device that carries out a specific task using three or more different types of simple machines (MS-ETS1-1)
11. Design and build a structure (or design a process) that conforms to specific design constraints (e.g., type and amount of materials) (MS-ETS1-1, MS-ETS1-2)
12. Evaluate competing design solutions for a given problem or goal (MS-ETS1-3)
13. Analyze data from tests to determine the best design for a given purpose (MS-ETS1-3)

**Astronomy/Space Science:**

1. Model features of the Earth/Moon planetary system (MS-ESS1-1)
2. Using evidence, describe currently accepted theories of the creation of the solar system, including the earth and the moon (MS-ESS1-1, MS-ESS1-2)
3. Identify and describe historical models of the solar system; give observational evidence for each model (MS-ESS1-1)
4. Describe the features of the planets of our solar system (MS-ESS1-3)
5. Analyze and interpret data to determine scale properties of objects in the solar system (MS-ESS1-3)
6. Describe evidence for the existence of extra-solar planets (MS-ESS1-2)
7. Describe the features of the sun and other main-sequence stars (MS-ESS1-2)
8. Describe & model the life cycle of stars (MS-ESS1-2)
9. Describe how stars produce light and heat (MS-PS1-4)
10. Make predictions of the fate of the earth based on the life cycle of stars (MS-ESS1-a)
11. Describe how black holes form (MS-ESS1-a)
12. Describe effects of black holes (MS-ESS1-a)
13. Give evidence for the existence of black holes (MS-ESS1-a)
14. Describe galaxies as “island universes” (MS-ESS1-2)
15. Using evidence, describe currently accepted theories of the creation, probable age, and eventual fate of the universe (MS-ESS1-4)
16. Model how rockets work (both traditional and newer designs) (MS-ETS1-1)
17. Identify uses of artificial satellites (MS-ETS1-1)
18. Outline history of human space exploration (MS-ESS1-2)

**Evolution:**

1. Define “theory” in the scientific sense (sp-2)
2. Describe major ideas contained within Darwin’s theory of evolution (common ancestry, natural selection) (MS-LS4-1, MS-LS4-2, MS-LS4-3, MS-LS4-4, MS-LS4-5, MS-LS4-6)
3. Model the process of natural selection (MS-LS4-4)
4. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the survival and growth of organisms (MS-LS4-4)
5. Identify and describe evidence in favor of the theory of evolution (MS-LS4-1, MS-LS4-2, MS-LS4-3,

MS-LS4-4, MS-LS4-5, MS-LS4-6)

1. Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction and change of life forms throughout time (MS-LS4-1)
2. Analyze pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships between them (MS-LS4-3)
3. Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time (MS-LS4-6)
4. Describe the process of speciation (MS-LS4-2)
5. Describe the role of the theory of evolution in modern biological sciences (CC, systems/models)
6. Gather and synthesize information about technologies that have changed the way humans influence the inheritance of desired traits (e.g., GMOs) (MS-LS4-5)
7. Identify & describe objections to evolution put forward by some non-scientists, and scientific responses to those objections (sp-7)
8. Describe the position of the Catholic Church on the theory of evolution (Not included in NGSS)
9. Using evidence, describe/model the evolution of a single plant or animal species (MS-LS4-1, MS-LS4-2, MS-LS4-3, MS-LS4-4, MS-LS4-5, MS-LS4-6)
10. Describe the evolution of biological life over the history of Earth (MS-LS4-6)
11. Identify and describe currently accepted ideas about how single-celled terrestrial life first evolved

(MS-LS4-5)

**Climate & Weather:**

1. Differentiate between weather and climate (MS-ESS2-4, MS-ESS2-6)
2. Identify major gases in Earth’s atmosphere (MS-ESS2-5)
3. Identify and describe layers of Earth’s atmosphere (MS-ESS-5)
4. Describe effects of major gases in Earth’s atmosphere (e.g., water vapor, CO2) (MS-ESS2—2)
5. Model the creation of clouds/precipitation (MS-ESS2-4)
6. Identify and describe types of clouds (MS-ESS-4)
7. Describe how wind is produced (MS-ESS2-5)
8. Collect data to provide evidence for how the motions and interactions of air masses result in changes in weather conditions (MS-ESS2-5)
9. Develop and use a model to describe how unequal heating and rotation of the earth cause atmospheric circulation that determine regional climates (MS-ESS2-6)
10. Read and interpret weather maps and station guides (sp-4)
11. Create and use a simple weather station (temperature, barometric pressure) to make predictions about local weather conditions (MS-ESS2-1)
12. Describe how tornadoes and hurricanes are formed (MS-ESS2-5)
13. Identify major climate zones of the earth; describe how biomes are affected by these climate zones (MS-ESS2-6
14. Analyze and interpret data to describe possible causes and effects of rapid global climate changes during the last century and ours (MS-ESS3-5)

**8th Grade:**

**Scientific Processes:**

1. Make measurements using metric units (sp-4)
2. Convert metric measurements (sp-5)
3. Use standard measuring tools safely (beakers, graduated cylinders, beam balances, etc.) (sp-3)
4. Define the nature of science and scientific models (sp-1, sp-2, sp-6)
5. Describe steps of the scientific method (sp-1, sp-3)
6. Write hypotheses supported by current or previous observations (sp-2, sp-3)
7. Describe types of observations (qualitative, quantitative) (sp-1, sp-3)
8. Make inferences supported by evidence (sp-6, sp-7)
9. Identify types of variables in a scientific investigation (sp-3)
10. Conduct background research and support findings in a coherent essay containing citations (sp-7, sp-8)
11. Design and carry out a scientific investigation (sp-3)
12. Describe (in essay form) the outcomes and real-world implications of scientific investigations (sp-7, sp-8, MS-ESS3-4)

**Matter & Its Interactions:**

1. Define matter (MS-PS1-1)
2. Measure/calculate the mass, volume and density of given types of matter (sp-5)
3. Describe types of matter according to their physical and chemical properties (MS-PS1-2)
4. Relate the density of matter to its temperature and state (liquid, solid, gas) (MS-PS1-4)
5. Differentiate between physical and chemical changes (MS-PS1-2)
6. Identify observable changes during physical and chemical reactions (MS-PS1-2)
7. Analyze and interpret data on the properties of substances before and after substances interact to determine if a chemical reaction has occurred (MS-PS1-2, MS-PS1-5)
8. Describe the particle model of matter (MS-PS1-1)
9. Identify and describe historical and modern models of the atom (MS-PS1-1)
10. Use the periodic table of elements to make inferences about the atomic structure of given elements (MS-PS1-1)
11. Develop models to describe the atomic composition of simple molecules and extended structures (MS-PS1-1)
12. 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 (MS-PS1-4)
13. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction (i.e., mass is conserved) (MS-PS1-5)
14. Use chemical formulas to infer the composition of chemical compounds (MS-PS1-1, MS-PS1-4)
15. Balance chemical equations (MS-PS1-4)
16. Gather and make sense of information to describe the creation and uses of synthetic materials (MS-PS1-3)

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**Energy & Energy Transfer:**

1. Define waves as a transfer of energy (MS-PS4-1, MS-PS4-2)
2. Describe types of waves (transverse, compression) (MS-PS4-2)
3. Describe characteristics of waves (MS-PS4-2)
4. Describe behaviors of waves (MS-PS4-1)
5. Develop and use a model to describe that waves are reflected, absorbed or transmitted through various materials (MS-PS4-2)
6. Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy contained in the wave (MS-PS4-1)
7. Differentiate between mechanical and electromagnetic waves (MS-PS4-1, MS-PS4-2)
8. Describe the nature of electromagnetic waves (MS-PS4-1)
9. Describe waves of the electromagnetic spectrum (MS-PS4-2)
10. Identify and describe types of energy (mechanical, electromagnetic, thermal) (MS-PS4-1, MS-PS4-2)
11. Interpret data to determine factors that affect the strength of electric and magnetic fields (MS-PS4-1)
12. Design & conduct an investigation that demonstrates that energy fields exist between objects that are not in physical contact with one another (MS-PS2-3)
13. Demonstrate that energy waves can be used for communication purposes (MS-PS4-3)
14. Describe how electrical energy is produced and transmitted (i.e, types of power plants); describe advantages and disadvantages to society of different means of electricity production (MS-PS4-3, MS-ETS1-2)
15. Design, construct and test a device that minimizes or maximizes thermal energy transfer (MS-PS3-3)

**Cell Biology & Heredity:**

1. Describe and model the structure of animal and plant cells, including the functions of the organelles within them (MS-LS1-1)
2. Conduct an investigation to provide evidence that living things are made of cells (MS-LS1-1)
3. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function (MS-LS1-2)
4. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells (MS-LS1-3)
5. Identify and describe layers of complexity within organisms (cells, tissues, organs, organ systems, organisms) (MS-LS1-2)
6. Design and carry out a scientific investigation that demonstrates the process of photosynthesis (HS-LS1-6)
7. Construct a scientific explanation based on evidence for the role of photosynthesis in the flow of energy into and out of organisms (MS-LS2-3)
8. Describe processes of osmosis & diffusion within cells (MS-LS1-3)
9. Describe the process of cellular respiration, and how this relates to respiration in larger organisms

(MS-LS1-3)

1. Model how cells reproduce (mitosis and meiosis) (MS-LS3-2)
2. Describe/ reproduce Mendel’s early experiments in heredity (MS-LS3-2)
3. Differentiate between dominant and recessive traits (MS-LS3-2)
4. Use a Punnett Square to predict the probability of the emergence of dominant and recessive traits (MS\_LS3-2)
5. Extract DNA from living cells (MS-LS3-2)
6. Model the structure of DNA molecules MS-LS3-1)
7. Describe the process of DNA replication within cells (MS-LS3-1)
8. Describe the role of DNA in inheritance (MS-LS3-1)
9. Develop and use a model to describe how mutations may result in harmful, neutral or beneficial changes to the structure and function of an organism or species (MS-LS3-1)
10. Using evidence, predict the effects on society of recent advancements in genetic knowledge (e.g., stem cell therapies, cloning) (sp-7, sp-8)