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ALIGNMENT AND PROGRESSIONS





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ALIGNMENT AND PROGRESSIONS

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Framework Alignment

GRADE	VOLUME	NGSS PERFORMANCE EXPECTATIONS			INTEGRATED 3-D CHALLENGE	MODULES
6	1	MS-LS1-1 MS-LS1-2 MS-LS1-3	MS-ETS1-1 MS-ETS1-2	MS-ETS1-3 MS-ETS1-4	How to Mend a Broken Heart	Under the Microscope
						CreATe Network
	2	MS-ESS2-4 MS-ESS2-5 MS-ESS2-6 MS-PS3-3 MS-PS3-4	MS-PS3-5 MS-PS1-4* MS-PS4-2* MS-LS1-7*	MS-ETS1-1* MS-ETS1-2* MS-ETS1-3* MS-ETS1-4*	Polar Survival	The Great Air Race
						Model Earth
						Life Through a Lens
	3	MS-LS1-4 MS-LS1-5 MS-LS1-8	MS-LS3-2 MS-PS4-3* MS-ESS2-4*	MS-ETS1-4*	Killer Plants	North Island Rescue
						Landscape of Fear
	4	MS-ETS1-1 MS-ETS1-2 MS-ETS1-3 MS-ETS1-4	MS-ESS3-3 MS-ESS3-5 MS-LS2-4* MS-ESS3-2*		A Connection to Home	The Heat Is On
						Emergency Hydration
7	5	MS-PS1-1 MS-PS1-3 MS-PS1-4 MS-PS1-6*	MS-ESS3-1 MS-ESS1-4* MS-ESS2-1* MS-ESS3-4*	MS-LS2-3* MS-LS2-4* MS-ETS1-1* MS-ETS1-2*	Cell Phones: Unboxed	The Resource Race
						The Plastic Tide
	6	MS-ESS2-1 MS-ESS2-2 MS-ESS2-3	MS-ESS3-2 MS-ESS1-4*	MS-PS1-2* MS-PS3-1*	Supereruptions	Volcano Hunters
						Dinosaur Trail
	7	MS-ETS1-1 MS-ETS1-3 MS-ETS1-4	MS-PS1-2 MS-PS1-5 MS-PS1-6	MS-PS1-1* MS-PS1-4* MS-ETS1-2*	A Natural Glow	Science on the Main Stage
						Turtle SOS
	8	MS-LS1-6 MS-LS1-7 MS-LS2-1 MS-LS2-2 MS-LS2-3 MS-LS2-4	MS-LS2-5 MS-LS1-2* MS-ETS1-1 MS-ETS1-2 MS-ETS1-3*	MS-ETS1-4* MS-ESS3-3* MS-ESS3-5* MS-PS1-5* MS-PS1-2*	Stop the Rot	Future Food
						A Place Called Home
						The Green Monster
8	9	MS-ESS1-1 MS-ESS1-2 MS-ESS1-3 MS-ESS1-4	MS-PS2-2 MS-PS3-1 MS-PS2-4* MS-PS2-5*	MS-ETS1-1* MS-ETS1-2* MS-ETS1-3* MS-ETS1-4*	SOS from Space	Ocean Powered
						Asteroid Alert!
	10	MS-ETS1-1 MS-ETS1-2 MS-PS2-1 MS-PS2-3	MS-PS2-4 MS-PS2-5 MS-PS3-2 MS-LS1-3*	MS-ESS1-2* MS-ESS1-3* MS-ETS1-3* MS-ETS1-4*	Mission to Mars	Collision Course
						Movie Magic
	11	MS-LS3-1 MS-LS4-1 MS-LS4-2 MS-LS4-3	MS-LS4-4 MS-LS4-5 MS-LS4-6 MS-LS1-1*	MS-LS1-5* MS-LS3-2* MS-ESS1-4* MS-ETS1-1*	Relative Giants	Are They Among Us?
						Survival Stories
	12	MS-ESS3-4 MS-PS4-1 MS-PS4-2 MS-PS4-3	MS-ETS1-1 MS-ETS1-3 MS-ETS1-2* MS-ETS1-4* MS-ESS3-3*	MS-LS1-4* MS-LS2-1* MS-LS2-4* MS-LS4-4*	A Vision of the Future	Amazon of the Oceans
						Into the Abyss
						Animal Tracks
						The Bees' Needs

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Grade 6 Suggested Scope and Sequence

	MODULE	STEAM ROLE STORYLINE	PERFORMANCE EXPECTATIONS	NGSS			
				Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Environmental Principles and Concepts
VOLUME 1	Under the Microscope	Students take on the role of medical students, scrubbing up and rotating through a hospital. By studying symptoms, investigating body systems, and observing microscopic cells, they diagnose patients' mystery maladies.	MS-LS1-1 Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. MS-LS1-2 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-LS1-3 Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	SEP-1, SEP-2, SEP-3, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2, CCC-3, CCC-4, CCC-6, CNS-7, CETAS-1	LS1.A	Principle I, Principle II, Principle IV
	CreATe Network	Inspired by the platform "CreATe Network," students identify the assistive technology needs of people with disabilities. Designing and testing their devices, students strive to engineer the perfect solution.	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. MS-LS1-3* Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	SEP-1, SEP-2, SEP-4, SEP-7	CCC-4, CCC-6, CNS-7, CETAS-2	LS1.A, ETS1.A, ETS1.B, ETS1.C	
VOLUME 2	The Great Air Race	As part of a team, students navigate the skies in a bid to win the Great Air Race. Providing weather reports and routing advice, they strive to reach the next airport in the quickest time... without heading straight into a storm!	MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. MS-ESS2-5 Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions. 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. 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.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2, CCC-4, CCC-5	PS1.A, PS3.B, ESS2.C, ESS2.D	Principle I, Principle III
	Model Earth	Climate models are the backbone of modern climate science. But how are they developed, and why are they used? Students will investigate the factors that affect climate, including atmospheric and oceanic circulation, and develop a global 3-D climate model.	MS-ESS2-6 Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates. 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-PS4-2* Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.	SEP-2, SEP-3, SEP-6, SEP-8	CCC-1, CCC-2, CCC-4, CCC-5, CCC-7	ESS2.C, ESS2.D, PS3.B, PS4.B	Principle I, Principle II, Principle III, Principle IV
	Life Through a Lens	For us humans, a lot of our planet is unhabitable. But even in the most extreme environments, from freezing tundras to arid deserts, animals can thrive. As documentary filmmakers, students turn the cameras on these survivors to capture how they do it.	MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. 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. 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-LS1-7* Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. 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.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8, CNS-2	CCC-2, CCC-3, CCC-5, CCC-6	PS3.A, PS3.B, PS3.D, LS1.C, ETS1.A, ESS2.C	Principle III

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NGSS STANDARDS KEY

SCIENCE AND ENGINEERING PRACTICES

SEP-1 Asking Questions and Defining Problems
SEP-2 Developing and Using Models
SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data
SEP-5 Using Mathematics and Computational Thinking
SEP-6 Constructing Explanations and Designing Solutions
SEP-7 Engaging in Argument from Evidence
SEP-8 Obtaining, Evaluating, and Communicating Information

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-1 Scientific Investigations Use a Variety of Methods
CNS-2 Scientific Knowledge is Based on Empirical Evidence
CNS-3 Scientific Knowledge is Open to Revision in Light of New Evidence
CNS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

CROSSCUTTING CONCEPTS

CCC-1 Patterns
CCC-2 Cause and Effect
CCC-3 Scale, Proportion, and Quantity
CCC-4 Systems and System Models
CCC-5 Energy and Matter
CCC-6 Structure and Function
CCC-7 Stability and Change

CONNECTIONS TO ENGINEERING,TECHNOLOGY, AND APPLICATIONS OF SCIENCE

CETAS-1 Interdependence of Science, Engineering, and Technology
CETAS-2 Influence of Engineering, Technology, and Science on Society and the Natural World

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-5 Science is a Way of Knowing
CNS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems
CNS-7 Science is a Human Endeavor
CNS-8 Science Addresses Questions About the Natural and Material World

DISCIPLINARY CORE IDEAS

PS1.A Structure and Properties of Matter
PS1.B Chemical Reactions
PS2.A Forces and Motion
PS2.B Types of Interactions
PS3.A Definitions of Energy
PS3.B Conservation of Energy and Energy Transfer
PS3.C Relationship between Energy and Forces
PS3.D Energy in Chemical Processes and Everyday Life
PS4.A Wave Properties
PS4.B Electromagnetic Radiation
PS4.C Information Technologies and Instrumentation

ETS1.A Defining and Delimiting Engineering Problems
ETS1.B Developing Possible Solutions
ETS1.C Optimizing the Design Solution

ESS1.A The Universe and Its Stars
ESS1.B Earth and the Solar System
ESS1.C The History of Planet Earth
ESS2.A Earth's Materials and Systems
ESS2.B Plate Tectonics and Large-Scale System Interactions
ESS2.C The Roles of Water in Earth's Surface Processes
ESS2.D Weather and Climate
ESS3.A Natural Resources
ESS3.B Natural Hazards
ESS3.C Human Impacts on Earth Systems
ESS3.D Global Climate Change

LS1.A Structure and Function
LS1.B Growth and Development of Organisms
LS1.C Organization for Matter and Energy Flow in Organisms
LS1.D Information Processing
LS2.A Interdependent Relationships in Ecosystems
LS2.B Cycles of Matter and Energy Transfer in Ecosystems
LS2.C Ecosystem Dynamics, Functioning, and Resilience
LS3.A Inheritance of Traits
LS3.B Variation of Traits
LS4.A Evidence of Common Ancestry and Diversity
LS4.B Natural Selection
LS4.C Adaptation
LS4.D Biodiversity and Humans

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

Principle I People Depend on Natural Systems
Principle II People Influence Natural Systems
Principle III Natural Systems Change in Ways that People Benefit From and Can Influence
Principle IV There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

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Grade 6 Suggested Scope and Sequence

	MODULE	STEAM ROLE STORYLINE	PERFORMANCE EXPECTATIONS	NGSS			
				Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Environmental Principles and Concepts
VOLUME 3	**North Island Rescue**	Some of New Zealand's unique plants and animals are at risk of extinction. What can we do to save the species? Students explore the genetic and environmental factors that affect growth, and develop an ecosystem survival plan for the North Island pollinators and the plants that rely on them.	MS-LS1-5 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation. MS-ESS2-4* Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. 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. 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.	SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2, CCC-5	LS1.B, LS3.A, LS3.B, ETS1.B, ETS1.C	Principle III
	Landscape of Fear	Students join ecologists in the field to investigate the landscape of fear, analyzing the behaviors of animals and traits of plants in an environment where species must fight to survive.	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. MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. MS-PS4-3* Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2	LS1.B, LS1.D, PS4.C	Principle III
VOLUME 4	**The Heat Is On**	Over the past century, we've built a world reliant on industrial processes. At the same time, global warming has increased to an unprecedented degree. Students develop an eco-city, taking inspiration from cities tackling climate change.	MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-5 Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. 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.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2, CCC-4, CCC-7, CETAS-2	ESS3.C, ESS3.D, LS2.C, ETS1.A, ETS1.B	Principle I, Principle II, Principle III, Principle IV, Principle V
	Emergency Hydration	As the climate warms, natural disasters are likely to get more dangerous and being prepared will be vital. Students design water filtration systems to help communities access clean drinking water when natural disasters strike.	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. 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-ESS3-2* Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. MS-ESS3-3* Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-7, SEP-8	CCC-2, CCC-6, CETAS-2	ETS1.A, ETS1.B, ETS1.C, ESS3.B, ESS3.C	Principle I, Principle II, Principle III, Principle IV, Principle V

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NGSS STANDARDS KEY

SCIENCE AND ENGINEERING PRACTICES

SEP-1 Asking Questions and Defining Problems
SEP-2 Developing and Using Models
SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data
SEP-5 Using Mathematics and Computational Thinking
SEP-6 Constructing Explanations and Designing Solutions
SEP-7 Engaging in Argument from Evidence
SEP-8 Obtaining, Evaluating, and Communicating Information

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-1 Scientific Investigations Use a Variety of Methods
CNS-2 Scientific Knowledge is Based on Empirical Evidence
CNS-3 Scientific Knowledge is Open to Revision in Light of New Evidence
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CROSSCUTTING CONCEPTS

CCC-1 Patterns
CCC-2 Cause and Effect
CCC-3 Scale, Proportion, and Quantity
CCC-4 Systems and System Models
CCC-5 Energy and Matter
CCC-6 Structure and Function
CCC-7 Stability and Change

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CETAS-1 Interdependence of Science, Engineering, and Technology
CETAS-2 Influence of Engineering, Technology, and Science on Society and the Natural World

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-5 Science is a Way of Knowing
CNS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems
CNS-7 Science is a Human Endeavor
CNS-8 Science Addresses Questions About the Natural and Material World

DISCIPLINARY CORE IDEAS

PS1.A Structure and Properties of Matter
PS1.B Chemical Reactions
PS2.A Forces and Motion
PS2.B Types of Interactions
PS3.A Definitions of Energy
PS3.B Conservation of Energy and Energy Transfer
PS3.C Relationship between Energy and Forces
PS3.D Energy in Chemical Processes and Everyday Life
PS4.A Wave Properties
PS4.B Electromagnetic Radiation
PS4.C Information Technologies and Instrumentation

ETS1.A Defining and Delimiting Engineering Problems
ETS1.B Developing Possible Solutions
ETS1.C Optimizing the Design Solution

ESS1.A The Universe and Its Stars
ESS1.B Earth and the Solar System
ESS1.C The History of Planet Earth
ESS2.A Earth's Materials and Systems
ESS2.B Plate Tectonics and Large-Scale System Interactions
ESS2.C The Roles of Water in Earth's Surface Processes
ESS2.D Weather and Climate
ESS3.A Natural Resources
ESS3.B Natural Hazards
ESS3.C Human Impacts on Earth Systems
ESS3.D Global Climate Change

LS1.A Structure and Function
LS1.B Growth and Development of Organisms
LS1.C Organization for Matter and Energy Flow in Organisms
LS1.D Information Processing
LS2.A Interdependent Relationships in Ecosystems
LS2.B Cycles of Matter and Energy Transfer in Ecosystems
LS2.C Ecosystem Dynamics, Functioning, and Resilience
LS3.A Inheritance of Traits
LS3.B Variation of Traits
LS4.A Evidence of Common Ancestry and Diversity
LS4.B Natural Selection
LS4.C Adaptation
LS4.D Biodiversity and Humans

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

Principle I People Depend on Natural Systems
Principle II People Influence Natural Systems
Principle III Natural Systems Change in Ways that People Benefit From and Can Influence
Principle IV There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

Under the Microscope Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *What happens to our bodies when we get injured or sick?*		
4-LS1-1 From Molecules to Organisms: Structures and Processes Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction **SEP-7** Engaging in Argument from Evidence Construct and/or support an argument with evidence, data, and/or a model **LS1.A** Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction **CCC-4** Systems and System Models A system can be described in terms of its components and their interactions **CNS-7** Science is a Human Endeavor Most scientists and engineers work in teams	**MS-LS1-3** From Molecules to Organisms: Structures and Processes Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells **SEP-7** Engaging in Argument from Evidence Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon **LS1.A** Structure and Function In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions **CCC-4** Systems and System Models Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems **CNS-7** Science is a Human Endeavor Scientists and engineers are guided by habits of mind such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas	**HS-LS1-1** From Molecules to Organisms: Structures and Processes Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells **SEP-7** Engaging in Argument from Evidence Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence **LS1.A** Structure and Function Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level **CCC-4** Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales **CNS-7** Science is a Human Endeavor Science and engineering are influenced by society and science has influenced advances in technology

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-3 *From Molecules to Organisms: Structures and Processes*			
SEP-7	Lesson 1 Session 2 Lesson 1 Session 4	Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
LS1.A	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
CCC-4	NA	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
CNS-7	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 6	Lesson 2 Session 1 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *What evidence can we use to figure out why someone is sick?*		
4-LS1-1 From Molecules to Organisms: Structures and Processes Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction **SEP-3** Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered **LS1.A** Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction **CCC-3** Scale, Proportion, and Quantity Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods **CETAS-1** Interdependence of Science, Engineering, and Technology Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies	**MS-LS1-1** From Molecules to Organisms: Structures and Processes Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells **SEP-3** Planning and Carrying Out Investigations Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation **LS1.A** Structure and Function All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular) **CCC-3** Scale, Proportion, and Quantity Phenomena that can be observed at one scale may not be observable at another scale **CETAS-1** Interdependence of Science, Engineering, and Technology Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems	**HS-LS1-3** From Molecules to Organisms: Structures and Processes Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis **SEP-3** Planning and Carrying Out Investigations Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly **LS1.A** Structure and Function Systems of specialized cells within organisms help them perform the essential functions of life **CCC-3** Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs **CETAS-1** Interdependence of Science, Engineering, and Technology Science and engineering complement each other in the cycle known as research and development (R&D). Many R&D projects may involve scientists, engineers, and others with wide ranges of expertise

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-1 *From Molecules to Organisms: Structures and Processes*			
SEP-3	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
LS1.A	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
CCC-3	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
CETAS-1	NA	Lesson 2 Session 1 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | **Driving Question** *Why do illnesses such as sickle cell anemia affect the whole body?*		
4-LS1-2 From Molecules to Organisms: Structures and Processes Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **LS1.A** Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction **CCC-6** Structure and Function Different materials have different substructures, which can sometimes be observed	**MS-LS1-2** From Molecules to Organisms: Structures and Processes Develop and use a model to describe the function of a cell as a whole and ways the parts of cells contribute to the function **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **LS1.A** Structure and Function Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell **CCC-6** Structure and Function Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function	**HS-LS1-2** From Molecules to Organisms: Structures and Processes Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms **SEP-2** Developing and Using Models Use a model to provide mechanistic accounts of phenomena **LS1.A** Structure and Function Systems of specialized cells within organisms help them perform the essential functions of life **CCC-6** Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-2 *From Molecules to Organisms: Structures and Processes*			
SEP-2	NA	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
LS1.A	NA	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CCC-6	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6

CreATe Network Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we develop assistive technology to support individual needs?*		
3–5-ETS1-1 Engineering Design Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost **SEP-1** Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost **ETS1.A** Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World People's needs and wants change over time, as do their demands for new and improved technologies Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands **3–5-ETS1-2** Engineering Design Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem **SEP-7** Engaging in Argument from Evidence Make a claim about the effectiveness of an object, tool, or solution that is supported by relevant evidence **ETS1.B** Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions **3–5-ETS1-2** Engineering Design Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem **SEP-4** Analyzing and Interpreting Data Analyze data to refine a problem statement or the design of a proposed object, tool, or process **ETS1.B** Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved **ETS1.C** Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints	**MS-ETS1-1** Engineering Design 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 **SEP-1** Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions **ETS1.A** Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions **MS-ETS1-2** Engineering Design Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem **MS-ETS1-3** Engineering Design 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 **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors	**HS-ETS1-1** Engineering Design Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants **SEP-1** Asking Questions and Defining Problems Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations **ETS1.A** Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World Engineers continuously modify these systems to increase benefits while decreasing costs and risks. New technologies can have deep impacts on society and the environment, including some that were not anticipated Analysis of costs and benefits is a critical aspect of decisions about technology **HS-ETS1-2** Engineering Design Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations) **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts **HS-ETS1-3** Engineering Design Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts **SEP-4** Analyzing and Interpreting Data Evaluate the impact of new data on a working explanation and/or model of a proposed process or system **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts

3–5-ETS1-3 Engineering Design
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

SEP-2 Developing and Using Models
Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system

ETS1.B Developing Possible Solutions
Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions

Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved

ETS1.C Optimizing the Design Solution
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints

ETS1.C Optimizing the Design Solution
Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design

MS-ETS1-4 Engineering Design
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

SEP-2 Developing and Using Models
Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs

ETS1.B Developing Possible Solutions
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it

Models of all kinds are important for testing solutions

ETS1.C Optimizing the Design Solution
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution

ETS1.C Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

HS-ETS1-4 Engineering Design
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

SEP-2 Developing and Using Models
Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems

ETS1.B Developing Possible Solutions
When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts

Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs

ETS1.C Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ETS1-1 *Engineering Design*			
SEP-1	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 10
ETS1.A[a]	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 10
CETAS-2[b]	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4
MS-ETS1-2 *Engineering Design*			
SEP-7[c]	NA	Lesson 1 Session 2	Lesson 1 Session 5 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.B[d]	NA	Lesson 1 Session 2	Lesson 1 Session 5 Lesson 1 Session 8 Lesson 1 Session 10
MS-ETS1-3 *Engineering Design*			
SEP-4	Lesson 1 Session 4	Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 10
ETS1.B[e]	NA	Lesson 1 Session 2	Lesson 1 Session 5 Lesson 1 Session 8 Lesson 1 Session 10
ETS1-C[f]	NA	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9	Lesson 1 Session 10
MS-ETS1-4 *Engineering Design*			
SEP-2[g]	Lesson 1 Session 2 Lesson 1 Session 5	Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 10
ETS1.B[h]	NA	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8	Lesson 1 Session 10
ETS1.C[i]	NA	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9	Lesson 1 Session 10

[a] The relationship between the precise definition of criteria and constraints and a successful design solution, and the importance of considering scientific principles, are addressed in the Turtle SOS, The Green Monster, and The Bees' Needs modules.

[b] The role of natural resources in human activity, the consequences of human activity, and the impact of factors like climate and natural resources on technology use are fully mastered in the Turtle SOS, The Green Monster, and The Bees' Needs modules.

[c] The evaluation of competing solutions is fully mastered in the The Green Monster module and addressed again in the Collision Course module.

[d] The systematic nature of testing is revisited and fully mastered in the Collision Course module.

[e] The systematic nature of testing is revisited and fully mastered in the Collision Course module. The concept that a solution made up of parts of previous solutions can be better than its predecessors is revisited in the Turtle SOS module and fully mastered in the Emergency Hydration and The Bees' Needs modules..

[f] The idea that characteristics of partially successful designs can be incorporated during the redesign process is also addressed in the Emergency Hydration and Turtle SOS modules, and fully mastered in the The Bees' Needs module.

[g] The concept of a model as a system is fully mastered in the Emergency Hydration and Collision Course modules.

[h] The importance of testing a solution and modifying it based on the test results is fully mastered in the Emergency Hydration and Collision Course modules.

[i] The importance of an iterative testing process is addressed and mastered across the Emergency Hydration, Turtle SOS, and Collision Course modules.



The Great Air Race Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *Can we predict if it will rain?*		
5-ESS2-1 Earth's Systems Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **ESS2.C** The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most freshwater is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere **CCC-5** Energy and Matter Energy can be transferred in various ways and between objects. Matter is made of particles	**MS-ESS2-4** Earth's Systems Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity **SEP-2** Developing and Using Models Develop a model to describe unobservable mechanisms **ESS2.C** The Roles of Water in Earth's Surface Processes Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. Global movements of water and its changes in form are propelled by sunlight and gravity **CCC-5** Energy and Matter Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter	**HS-ESS2-4** Earth's Systems Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate **SEP-2** Developing and Using Models Use a model to provide mechanistic accounts of phenomena **ESS2.C** The Roles of Water in Earth's Surface Processes The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks **CCC-5** Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS2-4 *Earth's Systems*			
SEP-2	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8
ESS2.C[a]	NA	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8
CCC-5	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8

[a] Students extensively cover the cycling of matter within a natural system in the A Place Called Home module, and also cover the transfer of energy from one place to another in the Life Through a Lens and Turtle SOS modules.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | **Driving Question** *Can we predict if it will be stormy?* **Lesson 3** | **Driving Question** *What effect do landforms have on weather and on flight paths?*		
3-ESS2-1 Earth's Systems Represent data in tables and graphical displays to describe typical weather conditions expected during a particular season **SEP-3** Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution **ESS2.C** The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere **ESS2.D** Weather and Climate Scientists record patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change	**MS-ESS2-5** Earth's Systems Collect data to provide evidence for how the motions and complex interactions of air masses result in changes in weather conditions **SEP-3** Planning and Carrying Out Investigations Collect data to produce data to serve as the basis for evidence to answer scientific questions or test design solutions under a range of conditions **ESS2.C** The Roles of Water in Earth's Surface Processes The complex patterns of the changes and the movement of water in the atmosphere, determined by winds, landforms, and ocean temperatures and currents, are major determinants of local weather patterns **ESS2.D** Weather and Climate Because these patterns are so complex, weather can only be predicted probabilistically **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems	**HS-ESS2-5** Earth's Systems Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes **SEP-3** Planning and Carrying Out Investigations Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled **ESS2.C** The Roles of Water in Earth's Surface Processes The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks **ESS2.D** Weather and Climate The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS2-5 *Earth's Systems*			
SEP-3	Lesson 2 Session 5	Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 4 Lesson 2 Session 6	Lesson 2 Session 7 Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
ESS2.C	Lesson 2 Session 1 Lesson 2 Session 3	Lesson 2 Session 2 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
ESS2.D	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5	Lesson 2 Session 6 Lesson 2 Session 7 Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
CCC-2	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5

Model Earth Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | **Driving Question** *Does the location of a place influence its climate? If so, why?* **Lesson 2** | **Driving Question** *Does the atmosphere affect climate? If so, why?* **Lesson 3** | **Driving Question** *Do oceans affect climate? If so, why?*		
5-ESS2-1 Earth's Systems Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **ESS2.C** The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere **ESS2.D** Weather and Climate Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years **CCC-4** Systems and System Models A system can be described in terms of its components and their interactions	**MS-ESS2-6** Earth's Systems Develop and use a model to describe how unequal heating and rotation of the Earth cause patterns of atmospheric and oceanic circulation that determine regional climates **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **ESS2.C** The Roles of Water in Earth's Surface Processes Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents **ESS2.D** Weather and Climate Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents **CCC-4** Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems	**HS-ESS2-6** Earth's Systems Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere **SEP-2** Developing and Using Models Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations **ESS2.C** The Roles of Water in Earth's Surface Processes The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks **ESS2.D** Weather and Climate The foundation for Earth's global climate systems is the electromagnetic radiation from the sun, as well as its reflection, absorption, storage, and redistribution among the atmosphere, ocean, and land systems, and this energy's re-radiation into space **CCC-4** Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS2-6 *Earth's Systems*			
SEP-2	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
ESS2.C	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 6 Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
ESS2.D	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 3 Session 1	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CCC-4[a]	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 2 Session 1 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 3 Session 1 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6

[a] How models can be used to represent information flows is mastered in the Animal Tracks module.

Life Through a Lens Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How do animals survive in extremely hot environments?*		
4-PS3-2 Energy Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents **SEP-7** Engaging in Argument from Evidence Construct and/or support an argument with evidence, data, and/or a model **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science findings are based on recognizing patterns **PS3.B** Conservation of Energy and Energy Transfer Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced **CCC-5** Energy and Matter Energy can be transferred in various ways and between objects	**MS-PS3-5** Energy 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 **SEP-7** Engaging in Argument from Evidence Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations **PS3.B** Conservation of Energy and Energy Transfer When the motion energy of an object changes, there is inevitably some other change in energy at the same time **CCC-5** Energy and Matter Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion)	**HS-PS3-1** Energy 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 **SEP-7** Engaging in Argument from Evidence Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science knowledge is based on empirical evidence **PS3.B** Conservation of Energy and Energy Transfer Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system **CCC-5** Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS3-5 *Energy*			
SEP-7	Lesson 1 Session 2	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7
CNS-2	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7
PS3.B	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7
CCC-5	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How do animals survive in extremely cold environments?*		
4-PS3-2 Energy Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents **SEP-3** Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science findings are based on recognizing patterns **PS3.A** Definitions of Energy The faster a given object is moving, the more energy it possesses **PS3.B** Conservation of Energy and Energy Transfer Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced **CCC-3** Scale, Proportion, and Quantity Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods	**MS-PS3-4** Energy 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 **SEP-3** Planning and Carrying Out Investigations Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations **PS3.A** Definitions of Energy Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present **PS3.B** Conservation of Energy and Energy Transfer The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment **CCC-3** Scale, Proportion, and Quantity Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes	**HS-PS3-4** Energy Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperatures are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics) **SEP-3** Planning and Carrying Out Investigations Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly **CNS-2** Science Knowledge is Based on Empirical Evidence Science knowledge is based on empirical evidence **PS3.A** Definitions of Energy These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space **PS3.B** Conservation of Energy and Energy Transfer Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems **CCC-3** Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS3-4 *Energy*			
SEP-3	NA	Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 6	Lesson 2 Session 8
CNS-2	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8
PS3.A	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8
PS3.B	NA	Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8
CCC-3	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | **Driving Question** *How can we film in the Arctic Ocean?*		
4-PS3-4 Energy Apply scientific ideas to design, test, and refine a device that converts energy from one form to another **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas to solve design problems **PS3.A** Definitions of Energy The faster a given object is moving, the more energy it possesses **PS3.B** Conservation of Energy and Energy Transfer Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy **ETS1.A** Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account **ETS1.B** Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved **CCC-5** Energy and Matter Energy can be transferred in various ways and between objects	**MS-PS3-3** Energy Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system **PS3.A** Definitions of Energy Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present **PS3.B** Conservation of Energy and Energy Transfer Energy is spontaneously transferred out of hotter regions or objects and into colder ones **ETS1.A** Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions (secondary) **ETS1.B** Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results in order to improve it There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem (secondary) **CCC-5** Energy and Matter The transfer of energy can be tracked as energy flows through a designed or natural system	**HS-PS3-4** Energy 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) **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects **PS3.A** Definitions of Energy Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms **PS3.B** Conservation of Energy and Energy Transfer Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down) **ETS1.A** Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts **CCC-5** Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS3-3 *Energy*			
SEP-6	NA	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3	Lesson 3 Session 4
PS3.A	NA	Lesson 3 Session 2 Lesson 3 Session 3	Lesson 3 Session 4
PS3.B	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
ETS1.A	NA	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
ETS1.B	NA	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4
CCC-5	Lesson 3 Session 1	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5

North Island Rescue Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | **Driving Question** *Why do species have different traits?* **Lesson 3** | **Driving Question** *How does the environment affect how organisms grow?*		
3-LS1-1 From Molecules to Organisms: Structures and Processes Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death **SEP-6** Constructing Explanations and Designing Solutions Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem **LS1.B** Growth and Development of Organisms Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles **CCC-2** Cause and Effect Relationships are routinely identified, tested, and used to explain change	**MS-LS1-5** From Molecules to Organisms: Structures and Processes Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms **SEP-6** Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **LS1.B** Growth and Development of Organisms Genetic factors as well as local conditions affect the growth of the adult plant **CCC-2** Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability	**HS-LS1-5** From Molecules to Organisms: Structures and Processes Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy **SEP-6** Constructing Explanations and Designing Solutions Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **LS1.B** Growth and Development of Organisms In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-5 *From Molecules to Organisms: Structures and Processes*			
SEP-6	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 7	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 6
LS1.B	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CCC-2	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 7 Lesson 3 Session 1	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How can we breed pollinators with specific traits?*		
3-LS3-2 Heredity: Inheritance and Variation of Traits Use evidence to support the explanation that traits can be influenced by the environment **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **LS1.B** Growth and Development of Organisms Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles **LS3.A** Inheritance of Traits Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment **LS3.B** Variation of Traits The environment also affects the traits that an organism develops **CCC-2** Cause and Effect Cause and effect relationships are routinely identified and used to explain change	**MS-LS3-2** Heredity: Inheritance and Variation of Traits Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **LS1.B** Growth and Development of Organisms Organisms reproduce either sexually or asexually, and transfer their genetic information to their offspring (secondary) **LS3.A** Inheritance of Traits Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited **LS3.B** Variation of Traits In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural systems	**HS-LS3-2** Heredity: Inheritance and Variation of Traits Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **LS1.B** Growth and Development of Organisms In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism **LS3.A** Inheritance of Traits Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function **LS3.B** Variation of Traits In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS3-2 *Heredity: Inheritance and Variation of Traits*			
SEP-2	Lesson 2 Session 1	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 6 Lesson 2 Session 7
LS1.B	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
LS3.A	NA	Lesson 2 Session 1	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 7
LS3.B	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 7
CCC-2	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7

Landscape of Fear Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *In what ways do species increase their chances of reproduction and survival?*		
4-LS1-1 From Molecules to Organisms: Structures and Processes Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction **SEP-7** Engaging in Argument from Evidence Construct and/or support an argument with evidence, data, and/or a model **LS1.B** Growth and Development of Organisms Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles **CCC-2** Cause and Effect Events that occur together with regularity might or might not be a cause and effect relationship **4-LS1-2** From Molecules to Organisms: Structures and Processes Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways **SEP-8** Obtaining, Evaluating, and Communicating Information Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence **LS1.D** Information Processing Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change	**MS-LS1-4** From Molecules to Organisms: Structures and Processes 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 **SEP-7** Engaging in Argument from Evidence Use an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem **LS1.B** Growth and Development of Organisms Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction **CCC-2** Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability **MS-LS1-8** From Molecules to Organisms: Structures and Processes Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories **SEP-8** Obtaining, Evaluating, and Communicating Information Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence **LS1.D** Information Processing Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural systems	**HS-LS1-1** From Molecules to Organisms: Structures and Processes Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells **SEP-7** Engaging in Argument from Evidence Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence **LS1.B** Growth and Development of Organisms In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects **HS-LS1-3** From Molecules to Organisms: Structures and Processes Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis **SEP-8** Obtaining, Evaluating, and Communicating Information Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-4 *From Molecules to Organisms: Structures and Processes*			
SEP-7	NA	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 9 Lesson 1 Session 10
LS1.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 9	Lesson 1 Session 10
CCC-2	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 10
MS-LS1-8 *From Molecules to Organisms: Structures and Processes*			
SEP-8[a]	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 10
LS1.D	Lesson 1 Session 6	Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CCC-2	Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8	Lesson 1 Session 9 Lesson 1 Session 10

[a] The assessment of the credibility, accuracy, and possible bias of texts is fully mastered in the Survival Stories and The Plastic Tide modules.

The Heat Is On Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | **Driving Question** *How can we monitor how our world is changing?* **Lesson 3** | **Driving Question** *What might our world look like in the future?*		
4-ESS3-2 Earth and Human Activity Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas to solve design problems **ESS3.C** Human Impacts on Earth Systems Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments **CCC-2** Cause and Effect Events that occur together with regularity might or might not be a cause and effect relationship **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands	**MS-ESS3-3** Earth and Human Activity Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system **ESS3.C** Human Impacts on Earth Systems Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise **CCC-2** Cause and Effect Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time	**HS-ESS3-4** Earth and Human Activity Evaluate or refine a technological solution that reduces impacts of human activities on natural systems **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects **ESS3.C** Human Impacts on Earth Systems The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS3-3 *Earth and Human Activity*			
SEP-6	Lesson 1 Session 1	Lesson 1 Session 3	Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
ESS3.C[a]	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CCC-2	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 3 Session 4 Lesson 3 Session 5	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3	Lesson 3 Session 6
CETAS-2	NA	Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 7 Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6

[a] Students encounter different Earth systems in more detail in the The Great Air Race module and learn extensively about the destruction of natural habitats in the A Place Called Home module.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *Why is our world under threat?*		
4-ESS3-1 Earth and Human Activity Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment **SEP-1** Asking Questions and Defining Problems Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships **CCC-7** Stability and Change Change is measured in terms of differences over time and may occur at different rates	**MS-ESS3-5** Earth and Human Activity Ask questions to clarify evidence of the factors that have caused the rise in global temperatures **SEP-1** Asking Questions and Defining Problems Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument **ESS3.D** Global Climate Change Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities **CCC-7** Stability and Change Stability might be disturbed either by sudden events or gradual changes that accumulate over time	**HS-ESS3-5** Earth and Human Activity 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's systems **SEP-1** Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information **ESS3.D** Global Climate Change Though the magnitudes of human impacts are greater than they have ever been, so too are human abilities to model, predict, and manage current and future impacts **CCC-7** Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS3-5 *Earth and Human Activity*			
SEP-1	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 6 Lesson 2 Session 7
ESS3.D	NA	Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
CCC-7	NA	Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 6 Lesson 2 Session 7

Emergency Hydration Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we design a portable system to make water safe to drink in emergency situations?*		
3–**5-ETS1-2** Engineering Design Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem **SEP-4** Analyzing and Interpreting Data Analyze data to refine a problem statement or the design of a proposed object, tool, or process **ETS1.B** Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions **ETS1.C** Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints **3–5-ETS1-3** Engineering Design Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved **SEP-2** Developing and Using Models Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system **ETS1.B** Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved **ETS1.C** Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints	**MS-ETS1-3** Engineering Design 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 **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors **ETS1.C** Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design **MS-ETS1-4** Engineering Design 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 **SEP-2** Developing and Using Models Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs **ETS1.B** Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it Models of all kinds are important for testing solutions **ETS1.C** Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution	**HS-ETS1-3** Engineering Design 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 **SEP-4** Analyzing and Interpreting Data Evaluate the impact of new data on a working explanation and/or model of a proposed process or system **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts **ETS1.C** Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed **HS-ETS1-4** Engineering Design 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 **SEP-2** Developing and Using Models Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems **ETS1.B** Developing Possible Solutions Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs **ETS1.C** Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ETS1-3 *Engineering Design*			
SEP-4	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 10
ETS1.B	Lesson 1 Session 1	Lesson 1 Session 3	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.C	Lesson 1 Session 1	Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 10
MS-ETS1-4 *Engineering Design*			
SEP-2	Lesson 1 Session 1	Lesson 1 Session 4	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 10
ETS1.B	Lesson 1 Session 1	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 10
ETS1.C	Lesson 1 Session 1	Lesson 1 Session 4	Lesson 1 Session 7 Lesson 1 Session 10

Grade 7 Suggested Scope and Sequence

	MODULE	STEAM ROLE STORYLINE	PERFORMANCE EXPECTATIONS	NGSS			
				Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Environmental Principles and Concepts
VOLUME 5	**The Resource Race**	We've developed technology that has transformed our world, but this wouldn't be possible without resources found within the Earth's crust. Students investigate relationships between human advancement and the planet that sustains it.	MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. MS-PS1-6* Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. 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. MS-ESS2-1* Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS3-4* Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.	SEP-1, SEP-2, SEP-4, SEP-6, SEP-8	CCC-1, CCC-2, CCC-3, CCC-5, CNS-8, CETAS-2	ESS1.C, ESS2.A, ESS3.A, ESS3.C, PS1.B	Principle I, Principle II, Principle III, Principle IV, Principle V
	The Plastic Tide	The Earth's oceans are swimming in over 25 million square kilometers of plastic. Students dive deep into the chemistry of materials and the science of recycling, aiming to figure out the problem and find solutions to slow the plastic tide.	MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures. MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. 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. MS-LS2-3* Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. 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.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-6, SEP-8	CCC-2, CCC-3, CCC-4, CCC-6, CCC-7, CETAS-1, CETAS-2	PS1.A, PS3.A, PS1.B, LS2.B, LS2.C, ETS1.A, ETS1.B	Principle I, Principle II, Principle III, Principle IV, Principle V
VOLUME 6	**Volcano Hunters**	Students investigate what makes volcanoes tick before analyzing real-life data from active volcanoes, assessing threat levels, and devising a plan to protect people from the dangers of eruptions.	MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. 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. MS-PS1-2* Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. 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.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2, CCC-3, CCC-6, CCC-7	PS1.A, PS3.A, ESS2.A, ESS3.B	Principle V
	Dinosaur Trail	Working with the curators of a prehistoric learning center, students investigate fossils and the geoscience processes that create and reveal them as they construct a dynamic new exhibit—the Dinosaur Trail.	MS-ESS2-2 Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. 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. MS-PS1-2* Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. 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.	SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8, CNS-3	CCC-1, CCC-2, CCC-3, CCC-7	PS1.A, ESS1.C, ESS2.A, ESS2.B, ESS2.C	Principle II, Principle IV

*Supporting PEs

NGSS STANDARDS KEY

SCIENCE AND ENGINEERING PRACTICES

SEP-1 Asking Questions and Defining Problems
SEP-2 Developing and Using Models
SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data
SEP-5 Using Mathematics and Computational Thinking
SEP-6 Constructing Explanations and Designing Solutions
SEP-7 Engaging in Argument from Evidence
SEP-8 Obtaining, Evaluating, and Communicating Information

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-1 Scientific Investigations Use a Variety of Methods
CNS-2 Scientific Knowledge is Based on Empirical Evidence
CNS-3 Scientific Knowledge is Open to Revision in Light of New Evidence
CNS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

CROSSCUTTING CONCEPTS

CCC-1 Patterns
CCC-2 Cause and Effect
CCC-3 Scale, Proportion, and Quantity
CCC-4 Systems and System Models
CCC-5 Energy and Matter
CCC-6 Structure and Function
CCC-7 Stability and Change

CONNECTIONS TO ENGINEERING,TECHNOLOGY, AND APPLICATIONS OF SCIENCE

CETAS-1 Interdependence of Science, Engineering, and Technology
CETAS-2 Influence of Engineering, Technology, and Science on Society and the Natural World

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-5 Science is a Way of Knowing
CNS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems
CNS-7 Science is a Human Endeavor
CNS-8 Science Addresses Questions About the Natural and Material World

DISCIPLINARY CORE IDEAS

PS1.A Structure and Properties of Matter
PS1.B Chemical Reactions
PS2.A Forces and Motion
PS2.B Types of Interactions
PS3.A Definitions of Energy
PS3.B Conservation of Energy and Energy Transfer
PS3.C Relationship between Energy and Forces
PS3.D Energy in Chemical Processes and Everyday Life
PS4.A Wave Properties
PS4.B Electromagnetic Radiation
PS4.C Information Technologies and Instrumentation

ETS1.A Defining and Delimiting Engineering Problems
ETS1.B Developing Possible Solutions
ETS1.C Optimizing the Design Solution

ESS1.A The Universe and Its Stars
ESS1.B Earth and the Solar System
ESS1.C The History of Planet Earth
ESS2.A Earth's Materials and Systems
ESS2.B Plate Tectonics and Large-Scale System Interactions
ESS2.C The Roles of Water in Earth's Surface Processes
ESS2.D Weather and Climate
ESS3.A Natural Resources
ESS3.B Natural Hazards
ESS3.C Human Impacts on Earth Systems
ESS3.D Global Climate Change

LS1.A Structure and Function
LS1.B Growth and Development of Organisms
LS1.C Organization for Matter and Energy Flow in Organisms
LS1.D Information Processing
LS2.A Interdependent Relationships in Ecosystems
LS2.B Cycles of Matter and Energy Transfer in Ecosystems
LS2.C Ecosystem Dynamics, Functioning, and Resilience
LS3.A Inheritance of Traits
LS3.B Variation of Traits
LS4.A Evidence of Common Ancestry and Diversity
LS4.B Natural Selection
LS4.C Adaptation
LS4.D Biodiversity and Humans

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

Principle I People Depend on Natural Systems
Principle II People Influence Natural Systems
Principle III Natural Systems Change in Ways that People Benefit From and Can Influence
Principle IV There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

Grade 7 Suggested Scope and Sequence

	MODULE	STEAM ROLE STORYLINE	PERFORMANCE EXPECTATIONS	NGSS			
VOLUME 7	Science on the Main Stage	Students take on the role of special effects technicians in the music industry, designing slime, fake snow, foam mountains, smoke, and colorful fire to dazzle audiences.	MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-5 Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. MS-LS1-8* Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. MS-PS1-1* Develop models to describe the atomic composition of simple molecules and extended structures. 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.	Science and Engineering Practices SEP-2, SEP-3, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8, CNS-2, CNS-4	Crosscutting Concepts CCC-1, CCC-2, CCC-5	Disciplinary Core Ideas PS1.A, PS1.B, LS1.D, ESS2.C	
	Turtle SOS	As turtles prepare to hatch and make their way to the ocean, a dangerous oil spill awaits. Can students design a solution to keep the eggs at the right temperature and transport them to cleaner waters?	MS-PS1-6 Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. 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-ETS1-3 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. 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-PS1-2* Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	Science and Engineering Practices SEP-1, SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8	Crosscutting Concepts CCC-2, CCC-4, CCC-5, CETAS-2	Disciplinary Core Ideas PS1.B, ETS1.A, ETS1.B, ETS1.C	Environmental Principles and Concepts Principle II, Principle III, Principle IV, Principle V
VOLUME 8	Future Food	What will we be eating in 2050? And how will the produce be grown? Investigating new technologies, food sources, and production methods, students reimagine mealtimes for a future generation.	MS-LS1-6 Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms. MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. MS-PS1-2* Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. MS-PS1-5* Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. MS-LS1-2* Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function.	Science and Engineering Practices SEP-2, SEP-3, SEP-4, SEP-6, SEP-8, CNS-2	Crosscutting Concepts CCC-1, CCC-2, CCC-3, CCC-4, CCC-5, CETAS-2	Disciplinary Core Ideas LS1.A, LS1.C, LS2.A, ESS3.A, PS1.A, PS3.D	Environmental Principles and Concepts Principle I, Principle II, Principle III, Principle IV, Principle V
	A Place Called Home	Students join scientists at the SAFE Project in Borneo to explore how changes to ecosystems can affect living things, and discover how to manage and repair an altered ecosystem.	MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services. MS-ESS3-3* Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. MS-ESS3-5* Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the≈past century.	Science and Engineering Practices SEP-1, SEP-2, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8, CNS-2	Crosscutting Concepts CCC-1, CCC-2, CCC-5, CCC-7, CNS-6, CNS-8, CETAS-2	Disciplinary Core Ideas LS2.A, LS2.B, LS2.C, LS4.D, ESS3.C, ESS3.D, ETS1.A, ETS1.B	Environmental Principles and Concepts Principle I, Principle II, Principle III, Principle IV, Principle V
	The Green Monster	Students become environmental engineers working on the banks of Lake Erie, developing a new and improved fertilizer solution that fulfills the needs of the community without harming the environment.	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. MS-ESS2-1* Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. MS-ESS3-3* Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	Science and Engineering Practices SEP-1, SEP-2, SEP-3, SEP-4, SEP-6, SEP-7	Crosscutting Concepts CCC-2, CCC-5, CCC-7, CETAS-2	Disciplinary Core Ideas ETS1.A, ETS1.B, ETS1.C, ESS2.A, ESS3.C	Environmental Principles and Concepts Principle I, Principle II, Principle III, Principle IV, Principle V

*Supporting PEs

NGSS STANDARDS KEY

SCIENCE AND ENGINEERING PRACTICES

SEP-1 Asking Questions and Defining Problems
SEP-2 Developing and Using Models
SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data
SEP-5 Using Mathematics and Computational Thinking
SEP-6 Constructing Explanations and Designing Solutions
SEP-7 Engaging in Argument from Evidence
SEP-8 Obtaining, Evaluating, and Communicating Information

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-1 Scientific Investigations Use a Variety of Methods
CNS-2 Scientific Knowledge is Based on Empirical Evidence
CNS-3 Scientific Knowledge is Open to Revision in Light of New Evidence
CNS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

CROSSCUTTING CONCEPTS

CCC-1 Patterns
CCC-2 Cause and Effect
CCC-3 Scale, Proportion, and Quantity
CCC-4 Systems and System Models
CCC-5 Energy and Matter
CCC-6 Structure and Function
CCC-7 Stability and Change

CONNECTIONS TO ENGINEERING,TECHNOLOGY, AND APPLICATIONS OF SCIENCE

CETAS-1 Interdependence of Science, Engineering, and Technology
CETAS-2 Influence of Engineering, Technology, and Science on Society and the Natural World

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-5 Science is a Way of Knowing
CNS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems
CNS-7 Science is a Human Endeavor
CNS-8 Science Addresses Questions About the Natural and Material World

DISCIPLINARY CORE IDEAS

PS1.A Structure and Properties of Matter
PS1.B Chemical Reactions
PS2.A Forces and Motion
PS2.B Types of Interactions
PS3.A Definitions of Energy
PS3.B Conservation of Energy and Energy Transfer
PS3.C Relationship between Energy and Forces
PS3.D Energy in Chemical Processes and Everyday Life
PS4.A Wave Properties
PS4.B Electromagnetic Radiation
PS4.C Information Technologies and Instrumentation

ETS1.A Defining and Delimiting Engineering Problems
ETS1.B Developing Possible Solutions
ETS1.C Optimizing the Design Solution

ESS1.A The Universe and Its Stars
ESS1.B Earth and the Solar System
ESS1.C The History of Planet Earth
ESS2.A Earth's Materials and Systems
ESS2.B Plate Tectonics and Large-Scale System Interactions
ESS2.C The Roles of Water in Earth's Surface Processes
ESS2.D Weather and Climate
ESS3.A Natural Resources
ESS3.B Natural Hazards
ESS3.C Human Impacts on Earth Systems
ESS3.D Global Climate Change

LS1.A Structure and Function
LS1.B Growth and Development of Organisms
LS1.C Organization for Matter and Energy Flow in Organisms
LS1.D Information Processing
LS2.A Interdependent Relationships in Ecosystems
LS2.B Cycles of Matter and Energy Transfer in Ecosystems
LS2.C Ecosystem Dynamics, Functioning, and Resilience
LS3.A Inheritance of Traits
LS3.B Variation of Traits
LS4.A Evidence of Common Ancestry and Diversity
LS4.B Natural Selection
LS4.C Adaptation
LS4.D Biodiversity and Humans

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

Principle I People Depend on Natural Systems
Principle II People Influence Natural Systems
Principle III Natural Systems Change in Ways that People Benefit From and Can Influence
Principle IV There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

The Resource Race Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *What effect will electric cars have on the Earth's resources?*		
4-ESS3-1 Earth and Human Activity Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment **SEP-6** Constructing Explanations and Designing Solutions Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem **ESS3.A** Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not **CCC-2** Cause and Effect Cause and effect relationships are routinely identified and used to explain change **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World People's needs and wants change over time, as do their demands for new and improved technologies	**MS-ESS3-1** Earth and Human Activity Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes **SEP-6** Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **ESS3.A** Natural Resources Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment	**HS-ESS3-1** Earth and Human Activity 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 **SEP-6** Constructing Explanations and Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **ESS3.A** Natural Resources All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS3-1 *Earth and Human Activity*			
SEP-6	NA	Lesson 1 Session 3 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 10
ESS3.A[a]	Lesson 1 Session 2	Lesson 1 Session 1 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8	Lesson 1 Session 9 Lesson 1 Session 10
CCC-2	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CETAS-2[b]	NA	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10

[a] Human dependence on natural resources from the biosphere is mastered in the The Heat Is On module. Human dependence on the atmosphere and oceans for fresh water through the water cycle is mastered in the The Great Air Race module.

[b] The many consequences of human activity on the natural environment and people's health are mastered across the CreATe Network, Turtle SOS, and The Bees' Needs modules. How all human activity draws on natural resources is mastered in the The Green Monster module.

The Plastic Tide Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *What are plastics made of?*		
5-PS1-1 Matter and Its Interactions Develop a model to describe that matter is made up of particles too small to be seen **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **PS1.A** Structure and Properties of Matter Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon and the effects of air on larger particles or objects **CCC-3** Scale, Proportion, and Quantity Natural objects exist from the very small to the immensely large	**MS-PS1-1** Matter and Its Interactions Develop models to describe the atomic composition of simple molecules and extended structures **SEP-2** Developing and Using Models Develop a model to predict and/or describe phenomena **PS1.A** Structure and Properties of Matter Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals) **CCC-3** Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small	**HS-PS1-1** Matter and Its Interactions 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 **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **PS1.A** Structure and Properties of Matter Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states **CCC-3** Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS1-1 *Matter and Its Interactions*			
SEP.2	Lesson 1 Session 1	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9
PS1.A	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9
CCC-3	Lesson 1 Session 1	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How can we recycle plastics?*		
5-PS1-4 Matter and Its Interactions Conduct an investigation to determine whether the mixing of two or more substances results in new substances **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **PS1.A** Structure and Properties of Matter Measurements of a variety of properties can be used to identify materials **PS3.A** Definitions of Energy Energy can be moved from place to place by moving objects or through sound, light, or electric currents **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change	**MS-PS1-4** Matter and Its Interactions 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 **SEP-2** Developing and Using Models Develop a model to predict and/or describe phenomena **PS1.A** Structure and Properties of Matter Gases and liquids are made of molecules or inert atoms that are moving about relative to each other In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter **PS3.A** Definitions of Energy The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects (secondary) The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material (secondary) **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems	**HS-PS1-4** Matter and Its Interactions 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 **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **PS1.A** Structure and Properties of Matter A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart **PS3.A** Definitions of Energy Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS1-4 *Matter and Its Interactions*			
SEP-2	Lesson 2 Session 2	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 6
PS1.A	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 6
CCC-2	Lesson 2 Session 1	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 6

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | **Driving Question** *How can we reduce the impact of plastics?*		
5-PS1-3 Matter and Its Interactions Make observations and measurements to identify materials based on their properties **SEP-8** Obtaining, Evaluating, and Communicating Information Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem **PS1.A** Structure and Properties of Matter Measurements of a variety of properties can be used to identify materials **PS1.B** Chemical Reactions When two or more different substances are mixed, a new substance with different properties may be formed No matter what reaction or change in properties occurs, the total weight of the substances does not change **CCC-6** Structure and Function Different materials have different substructures, which can sometimes be observed **CETAS-1** Interdependence of Science, Engineering, and Technology Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies **CETAS-2** Influence of Science, Engineering and Technology on Society and the Natural World People's needs and wants change over time, as do their demands for new and improved technologies	**MS-PS1-3** Matter and Its Interactions Gather and make sense of information to describe that synthetic materials come from natural resources and impact society **SEP-8** Obtaining, Evaluating, and Communicating Information Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence **PS1.A** Structure and Properties of Matter Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it **PS1.B** Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants **CCC-6** Structure and Function Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used **CETAS-1** Interdependence of Science, Engineering, and Technology Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems **CETAS-2** Influence of Science, Engineering and Technology on Society and the Natural World The uses of technologies and any limitation on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time	**HS-PS1-3** Matter and Its Interactions 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 **SEP-8** Obtaining, Evaluating, and Communicating Information Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source **PS1.A** Structure and Properties of Matter The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms **PS1.B** Chemical Reactions The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions **CCC-6** Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem **CETAS-1** Interdependence of Science, Engineering, and Technology Science and engineering complement each other in the cycle known as research and development (R&D) **CETAS-2** Influence of Science, Engineering and Technology on Society and the Natural World Engineers continuously modify these systems to increase benefits while decreasing costs and risks. New technologies can have deep impacts on society and the environment, including some that were not anticipated

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS1-3 *Matter and Its Interactions*			
SEP-8	Lesson 3 Session 1	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
PS1.A	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 5
PS1.B[a]	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
CCC-6	NA	Lesson 3 Session 2 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5
CETAS-1[b]	NA	Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5
CETAS-2[c]	NA	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5

[a] The characteristics of chemical processes are mastered in the Science on the Main Stage module.

[b] The concept of engineering advances leading to important discoveries in many fields of science is mastered in the Under the Microscope and Survival Stories modules.

[c] The impact of factors like climate, natural resources, and economic conditions on technology use are fully mastered across the CreATe Network, Turtle SOS, The Green Monster, and The Bees' Needs modules.

Volcano Hunters Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *Can we identify volcanoes in the landscape surrounding Kathmandu, Bougainville Island, Auckland, and Yogyakarta?*		
4-ESS2-1 Earth's Systems Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **ESS2.A** Earth's Materials and Systems Rainfall helps to shape the land and affects the types of living things found in a region. Water, ice, wind, living organisms, and gravity break rocks, soils, and sediments into smaller particles and move them around **CCC-7** Stability and Change Change is measured in terms of differences over time and may occur at different rates. Some systems appear stable, but over long periods of time will eventually change	**MS-ESS2-1** Earth's Systems Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **ESS2.A** Earth's Materials and Systems All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms **CCC-7** Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and processes at different scales, including the atomic scale	**HS-ESS2-3** Earth's Systems Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection **SEP-2** Developing and Using Models Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations **ESS2.A** Earth's Materials and Systems Evidence from deep probes and seismic waves, reconstructions of historical changes in Earth's surface and its magnetic field, and an understanding of physical and chemical processes lead to a model of Earth with a hot but solid inner core, a liquid outer core, a solid mantle and crust. Motions of the mantle and its plates occur primarily through thermal convection, which involves the cycling of matter due to the outward flow of energy from Earth's interior and gravitational movement of denser materials toward the interior **CCC-7** Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS2-1 *Earth's Systems*			
SEP-2	Lesson 1 Session 2	Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 8
ESS2.A[a]	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8
CCC-7	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8

[a] Energy flows within living organisms are mastered in the Future Food module. Energy flows within the atmosphere and hydrosphere are mastered in the The Great Air Race and Model Earth modules.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | **Driving Question** *Are all volcanoes equally dangerous to communities?* **Lesson 3** | **Driving Question** *How can we protect communities at risk from volcanoes?*		
4-ESS3-2 Earth and Human Activity Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans **SEP-4** Analyzing and Interpreting Data Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings **ESS3.B** Natural Hazards A variety of natural hazards result from natural processes. Humans cannot eliminate natural hazards but can take steps to reduce their impacts **CCC-1** Patterns Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products **CETAS-2** Influence of Science, Engineering and Technology on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands	**MS-ESS3-2** Earth and Human Activity Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings **ESS3.B** Natural Hazards Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events **CCC-1** Patterns Graphs, charts, and images can be used to identify patterns in data **CETAS-2** Influence of Science, Engineering and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time	**HS-ESS3-1** Earth and Human Activity 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 **SEP-4** Analyzing and Interpreting Data Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations **ESS3.B** Natural Hazards Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations **CCC-1** Patterns Empirical evidence is needed to identify patterns **CETAS-2** Influence of Science, Engineering and Technology on Society and the Natural World Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS3-2 *Earth and Human Activity*			
SEP-4	Lesson 2 Session 1 Lesson 3 Session 1	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
ESS3.B	Lesson 2 Session 1 Lesson 3 Session 1 Lesson 3 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CCC-1	Lesson 2 Session 1 Lesson 3 Session 1	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CETAS-2	Lesson 2 Session 5	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4	Lesson 3 Session 5 Lesson 3 Session 6

Dinosaur Trail Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | **Driving Question** *What are fossils and how do they form?* **Lesson 2** | **Driving Question** *How do we find fossils at the Earth's surface?*		
4-ESS1-1 Earth's Place in the Universe Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time **SEP-6** Constructing Explanations and Designing Solutions Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem **ESS2.A** Earth Materials and Systems Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. The ocean supports a variety of ecosystems and organisms, shapes landforms, and influences climate. Winds and clouds in the atmosphere interact with the landforms to determine patterns of weather **ESS2.C** The Roles of Water in Earth's Surface Processes Nearly all of Earth's available water is in the ocean. Most fresh water is in glaciers or underground; only a tiny fraction is in streams, lakes, wetlands, and the atmosphere **CCC-3** Scale, Proportion, and Quantity Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods	**MS-ESS2-2** Earth's Systems Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales **SEP-6** Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **ESS2.A** Earth Materials and Systems The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future **ESS2.C** The Roles of Water in Earth's Surface Processes Water's movements—both on the land and underground—cause weathering and erosion, which change the land's surface features and create underground formations **CCC-3** Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small	**HS-ESS2-1** Earth's Systems 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 **SEP-6** Constructing Explanations and Designing Solutions Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **ESS2.A** Earth Materials and Systems Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes **ESS2.C** The Roles of Water in Earth's Surface Processes The abundance of liquid water on Earth's surface and its unique combination of physical and chemical properties are central to the planet's dynamics. These properties include water's exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks **CCC-3** Scale, Proportion, and Quantity The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS2-2 *Earth's Systems*			
SEP-6[a]	Lesson 1 Session 1	Lesson 1 Session 4 Lesson 1 Session 6 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
ESS2.A	Lesson 1 Session 4	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 2 Session 1
ESS2.C	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6
CCC-3	NA	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 7 Lesson 2 Session 1 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 6

[a] Students learn how to assess the validity and credibility of a source in the The Plastic Tide module.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | Driving Question *What do fossils and other rock evidence tell us about the Earth's past*		
4-ESS2-2 Earth's Systems Analyze and interpret data from maps to describe patterns of Earth's features **SEP-4** Analyze and Interpret Data Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation **ESS1.C** The History of Planet Earth Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed **ESS2.B** Plate Tectonics and Large-Scale System Interactions The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth **CCC-1** Patterns Patterns of change can be used to make predictions **CNS-3** Scientific Knowledge is Open to Revision in Light of New Evidence Science explanations can change based on new evidence	**MS-ESS2-3** Earth's Systems Analyze and interpret data on the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of the past plate motions **SEP-4** Analyze and Interpret Data Analyze and interpret data to provide evidence for phenomena **ESS1.C** The History of Planet Earth Tectonic processes continually generate new ocean sea floor at ridges and destroy old sea floor at trenches (secondary) **ESS2.B** Plate Tectonics and Large-Scale System Interactions Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart **CCC-1** Patterns Patterns in rates of change and other numerical relationships can provide information about natural systems. **CNS-3** Scientific Knowledge is Open to Revision in Light of New Evidence Science findings are frequently revised and/or reinterpreted based on new evidence	**HS-ESS2-3** Earth's Systems Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection **SEP-4** Analyze and Interpret Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution **ESS1.C** The History of Planet Earth Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old **ESS2.B** Plate Tectonics and Large-Scale System Interactions Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust **CCC-1** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena **CNS-3** Scientific Knowledge is Open to Revision in Light of New Evidence Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS2-3 *Earth's Systems*			
SEP-4	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 7
ESS1.C	NA	Lesson 3 Session 4 Lesson 3 Session 5	Lesson 3 Session 7
ESS2.B[b]	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 6 Lesson 3 Session 7
CCC-1	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6 Lesson 3 Session 7
CNS-3	NA	Lesson 3 Session 3	Lesson 3 Session 4

[b] Students learn about how aquifers work and how they are formed underground in the The Resource Race module.

Science on the Main Stage Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How do chemical reactions produce stage effects?*		
5-PS1-2 Matter and its Interactions Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science findings are based on recognizing patterns **PS1.A** Structure and Properties of Matter The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish **PS1.B** Chemical Reactions No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this level.) The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish **CCC-1** Patterns Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products	**MS-PS1-2** Matter and its Interactions Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations **PS1.A** Structure and Properties of Matter Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it **PS1.B** Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants **CCC-1** Patterns Macroscopic patterns are related to the nature of microscopic and atomic-level structure	**HS-PS1-2** Matter and its Interactions 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 **SEP-4** Analyzing and Interpreting Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science arguments are strengthened by multiple lines of evidence supporting a single explanation **PS1.A** Structure and Properties of Matter The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states **PS1.B** Chemical Reactions The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions **CCC-1** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS1-2 *Matter and Its Interactions*			
SEP-4	NA	Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 9 Lesson 1 Session 10 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 8
CNS-2	Lesson 1 Session 1	Lesson 1 Session 5	Lesson 1 Session 6
PS1.A	Lesson 1 Session 1	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9	Lesson 1 Session 10 Lesson 2 Session 3 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
PS1.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10 Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
CCC-1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10	Lesson 1 Session 4	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 6 Lesson 2 Session 8

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *Why do chemical reactions produce stage effects?*		
5-PS1-4 Matter and its Interactions Conduct an investigation to determine whether the mixing of two or more substances results in new substances **SEP-2** Developing and Using Models Develop a diagram or simple physical prototype to convey a proposed object, tool, or process **CNS-4** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena Science explanations describe the mechanisms for natural events **PS1.B** Chemical Reactions When two or more different substances are mixed, a new substance with different properties may be formed **CCC-5** Energy and Matter Energy can be transferred in various ways and between objects	**MS-PS1-5** Matter and its Interactions Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved **SEP-2** Developing and Using Models Develop a model to describe unobservable mechanisms **CNS-4** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena Laws are regularities or mathematical descriptions of natural phenomena **PS1.B** Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, and thus mass does not change **CCC-5** Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes	**HS-PS1-5** Matter and its Interactions 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 **SEP-2** Developing and Using Models Use a model to provide mechanistic accounts of phenomena **CNS-4** Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena Laws are statements or descriptions of the relationships among observable phenomena **PS1.B** Chemical Reactions Chemical processes, their rates and whether or not energy is stored or released can be understood in terms of the collisions of molecules and rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy **CCC-5** Energy and Matter In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS1-5 *Matter and Its Interactions*			
SEP-2	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 7 Lesson 2 Session 9 Lesson 2 Session 10
CNS-4	NA	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5
PS1.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10 Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9 Lesson 2 Session 10
CCC-5	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 8 Lesson 2 Session 9 Lesson 2 Session 10

Turtle SOS Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we design an incubator to protect turtle eggs in transit?*		
5-PS1-4 Matter and its Interactions Conduct an investigation to determine whether the mixing of two or more substances results in new substances **SEP-6** Constructing Explanations and Designing Solutions Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution **PS1.B** Chemical Reactions When two or more different substances are mixed, a new substance with different properties may be formed **ETS1.B** Developing Possible Solutions Testing a solution involves investigating how well it performs under a range of likely conditions **ETS1.C** Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints **CCC-5** Energy and Matter Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems **3-5-ETS1-1** Engineering Design Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost **SEP-1** Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost **ETS1.A** Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account	**MS-PS1-6** Matter and its Interactions Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes **SEP-6** Constructing Explanations and Designing Solutions Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints **PS1.B** Chemical Reactions Some chemical reactions release energy, others store energy **ETS1.B** Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results in order to improve it (secondary) **ETS1.C** Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design (secondary) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution (secondary) **CCC-5** Energy and Matter The transfer of energy can be tracked as energy flows through a designed or natural system **MS-ETS1-1** Engineering Design 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 **SEP-1** Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions **ETS1.A** Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions	**HS-PS1-4** Matter and its Interactions 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 **SEP-6** Constructing Explanations and Designing Solutions Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations **PS1.B** Chemical Reactions Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy **ETS1.B** Developing Possible Solutions Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs **ETS1.C** Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed **CCC-5** Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system **HS-ETS1-1** Engineering Design Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants **SEP-1** Asking Questions and Defining Problems Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations **ETS1.A** Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them

3–**5-ETS1-2** Engineering Design
Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem

SEP-4 Analyzing and Interpreting Data
Analyze data to refine a problem statement or the design of a proposed object, tool, or process

ETS1.B Developing Possible Solutions
Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved

ETS1.C Optimizing the Design Solution
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints
3–5-ETS1-3 Engineering Design
Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

SEP-2 Developing and Using Models
Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system

ETS1.B Developing Possible Solutions
Testing a solution involves investigating how well it performs under a range of likely conditions

ETS1.C Optimizing the Design Solution
Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints

MS-ETS1-3 Engineering Design
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

SEP-4 Analyzing and Interpreting Data
Analyze and interpret data to determine similarities and differences in findings

ETS1.B Developing Possible Solutions
There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem

Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors

ETS1.C Optimizing the Design Solution
Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design

MS-ETS1-4 Engineering Design
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

SEP-2 Developing and Using Models
Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs

ETS1.B Developing Possible Solutions
A solution needs to be tested, and then modified on the basis of the test results, in order to improve it

Models of all kinds are important for testing solutions

ETS1.C Optimizing the Design Solution
The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution

HS-ETS1-3 Engineering Design
Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts

SEP-4 Analyzing and Interpreting Data
Evaluate the impact of new data on a working explanation and/or model of a proposed process or system

ETS1.B Developing Possible Solutions
When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts

ETS1.C Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

HS-ETS1-4 Engineering Design
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

SEP-2 Developing and Using Models
Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems

ETS1.B Developing Possible Solutions
Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs

ETS1.C Optimizing the Design Solution
Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS1-6 *Matter and Its Interactions*			
SEP-6	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 10
PS1.B	Lesson 1 Session 1	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.B	Lesson 1 Session 1	Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 10
ETS1.C	Lesson 1 Session 1	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8	Lesson 1 Session 10
CCC-5	Lesson 1 Session 1	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 9 Lesson 1 Session 10
MS-ETS1-1 *Engineering Design*			
SEP-1	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 5 Lesson 1 Session 10
ETS1.A	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 5 Lesson 1 Session 8 Lesson 1 Session 10
CETAS-2[a]	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
MS-ETS1-3 *Engineering Design*			
SEP-4	Lesson 1 Session 3	Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 10
ETS1.B	Lesson 1 Session 1	Lesson 1 Session 5	Lesson 1 Session 8 Lesson 1 Session 10
ETS1.C	Lesson 1 Session 1	Lesson 1 Session 8	Lesson 1 Session 10
MS-ETS1-4 *Engineering Design*			
SEP-2	Lesson 1 Session 1	Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.B	Lesson 1 Session 1	Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 10
ETS1.C	Lesson 1 Session 1	Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 10

[a] How human activity impacts the health of people, and the importance of factors such as natural resources and economic conditions, is fully mastered in the The Green Monster, Collision Course, and The Bees' Needs modules.



Future Food Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we grow more crops to feed a growing population?*		
5-LS1-1 From Molecules to Organisms: Structures and Processes Support an argument that plants get the materials they need for growth chiefly from air and water **SEP-6** Constructing Explanations and Designing Solutions Identify the evidence that supports particular points in an explanation **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science findings are based on recognizing patterns **LS1.C** Organization for Matter and Energy Flow in Organisms Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. Plants acquire their material for growth chiefly from air and water **PS3.D** Energy in Chemical Processes and Everyday Life The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use **CCC-5** Energy and Matter Matter flows and cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems.	**MS-LS1-6** From Molecules to Organisms: Structures and Processes Construct a scientific explanation based on evidence for the role of photosynthesis in the cycling of matter and flow of energy into and out of organisms **SEP-6** Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science knowledge is based upon logical connections between evidence and explanations **LS1.C** Organization for Matter and Energy Flow in Organisms Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use **PS3.D** Energy in Chemical Processes and Everyday Life The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen (secondary) **CCC-5** Energy and Matter Within a natural system, the transfer of energy drives the motion and/or cycling of matter	**HS-LS1-6** From Molecules to Organisms: Structures and Processes Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules **SEP-6** Constructing Explanations and Designing Solutions Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science disciplines share common rules of evidence used to evaluate explanations about natural systems **LS1.C** Organization for Matter and Energy Flow in Organisms The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen **PS3.D** Energy in Chemical Processes and Everyday Life The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis **CCC-5** Energy and Matter Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-6 *From Molecules to Organisms: Structures and Processes*			
SEP-6	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CNS-2	NA	Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
LS1.C	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
PS3.D	Lesson 1 Session 2 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8	Lesson 1 Session 9 Lesson 1 Session 10
CCC-5	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How can we reduce the impact of meat production on the planet?*		
5-PS3-1 Energy Use models to describe that energy in animals' food (used for body repair, growth, and motion, and to maintain body warmth) was once energy from the Sun **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **LS1.C** Organization for Matter and Energy Flow in Organisms Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion **PS3.D** Energy in Chemical Processes and Everyday Life The energy released from food was once energy from the sun that was captured by plants in the chemical process that forms plant matter (from air and water) **CCC-5** Energy and Matter Energy can be transferred in various ways and between objects	**MS-LS1-7** From Molecules to Organisms: Structures and Processes Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism **SEP-2** Developing and Using Models Develop a model to describe unobservable mechanisms **LS1.C** Organization for Matter and Energy Flow in Organisms Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy **PS3.D** Energy in Chemical Processes and Everyday Life Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials (secondary) **CCC-5** Energy and Matter Matter is conserved because atoms are conserved in physical and chemical processes	**HS-LS1-7** From Molecules to Organisms: Structures and Processes Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **LS1.C** Organization for Matter and Energy Flow in Organisms As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment **PS3.D** Energy in Chemical Processes and Everyday Life The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis **CCC-5** Energy and Matter Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS1-7 *From Molecules to Organisms: Structures and Processes*			
SEP-2	NA	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 10
LS1.C	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 8 Lesson 2 Session 10
PS3.D	Lesson 2 Session 2	Lesson 2 Session 4 Lesson 2 Session 5	Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9 Lesson 2 Session 10
CCC-5[a]	Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5	Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 10

[a] Conservation of matter in physical processes is fully mastered and assessed in the Science on the Main Stage module.

A Place Called Home Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How do rain forest species interact with each other?*		
5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **LS2.B** Cycle of Matter and Energy Transfer in Ecosystems Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water, from the environment, and release waste matter (gas, liquid, or solid) back into the environment **CCC-5** Energy and Matter Matter cycles can be tracked in terms of the weight of the substances before and after a process occurs. The total weight of the substances does not change. This is what is meant by conservation of matter. Matter is transported into, out of, and within systems **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems **3-LS2-1** Ecosystems: Interactions, Energy, and Dynamics Construct an argument that some animals form groups that help members survive **SEP-6** Constructing Explanations and Designing Solutions Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard) **LS2.A** Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem **CCC-1** Patterns Patterns can be used to make predictions	**MS-LS2-3** Ecosystems: Interactions, Energy, and Dynamics Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem **SEP-2** Developing and Using Models Develop a model to describe phenomena **LS2.B** Cycle of Matter and Energy Transfer in Ecosystems Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem **CCC-5** Energy and Matter The transfer of energy can be tracked as energy flows through a natural system **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation **MS-LS2-2** Ecosystems: Interactions, Energy, and Dynamics Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems **SEP-6** Constructing Explanations and Designing Solutions Construct an explanation that includes qualitative or quantitative relationships between variables that predict phenomena **LS2.A** Interdependent Relationships in Ecosystems Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared **CCC-1** Patterns Patterns can be used to identify cause and effect relationships	**HS-LS2-4** Ecosystems: Interactions, Energy, and Dynamics Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem **SEP-2** Developing and Using Models Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations **LS2.B** Cycle of Matter and Energy Transfer in Ecosystems Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved **CCC-5** Energy and Matter Changes of energy and matter in a system can be described in terms of energy flows and matter cycles into, out of, and within that system **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes the universe is a vast single system in which basic laws are consistent **HS-LS2-2** Ecosystems: Interactions, Energy, and Dynamics Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales **SEP-6** Constructing Explanations and Designing Solutions Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables **LS2.A** Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem **CCC-1** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS2-3 *Ecosystems: Interactions, Energy, and Dynamics*			
SEP-2	Lesson 1 Session 2 Lesson 1 Session 4	Lesson 1 Session 3 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7
LS2.B[a]	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7
CCC-5	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7
CNS-6	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 6	Lesson 1 Session 7
MS-LS2-2 *Ecosystems: Interactions, Energy, and Dynamics*			
SEP-6	Lesson 1 Session 1	Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7
LS2.A	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7
CCC-1	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7

[a] Students are assessed on atoms in greater depth in the Science on the Main Stage and Future Food modules.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How does deforestation affect rain forest ecosystems?*		
5-LS2-1 Ecosystems: Interactions, Energy, and Dynamics Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computations **LS2.A** Interdependent Relationships in Ecosystems The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change **3-LS4-4** Biological Evolution: Unity and Diversity Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change **SEP-7** Engaging in Argument from Evidence Construct and/or support an argument with evidence, data, and/or a model **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science uses tools and technologies to make accurate measurements and observations **LS2.C** Ecosystem Dynamics, Functioning, and Resilience When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die **CCC-7** Stability and Change Some systems appear stable, but over long periods of time will eventually change	**MS-LS2-1** Ecosystems: Interactions, Energy, and Dynamics Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena **LS2.A** Interdependent Relationships in Ecosystems Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction Growth of organisms and population increases are limited by access to resources **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems **MS-LS2-4** Ecosystems: Interactions, Energy, and Dynamics Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations **SEP-7** Engaging in Argument from Evidence Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science disciplines share common rules of obtaining and evaluating empirical evidence **LS2.C** Ecosystem Dynamics, Functioning, and Resilience Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations **CCC-7** Stability and Change Small changes in one part of a system might cause large changes in another part	**HS-LS2-1** Ecosystems: Interactions, Energy, and Dynamics Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales **SEP-4** Analyzing and Interpreting Data Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution **LS2.A** Interdependent Relationships in Ecosystems Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system **HS-LS2-6** Ecosystems: Interactions, Energy, and Dynamics Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions by changing conditions may result in new ecosystems **SEP-7** Engaging in Argument from Evidence Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence and challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining what additional information is required to resolve contradictions **CNS-2** Scientific Knowledge is Based on Empirical Evidence Science disciplines share common rules of evidence used to evaluate explanations about natural systems **LS2.C** Ecosystem Dynamics, Functioning, and Resilience A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability **CCC-7** Stability and Change Feedback (negative or positive) can stabilize or destabilize a system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS2-1 *Ecosystems: Interactions, Energy, and Dynamics*			
SEP-4	Lesson 2 Session 1	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
LS2.A	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
CCC-2	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
MS-LS2-4 *Ecosystems: Interactions, Energy, and Dynamics*			
SEP-7	NA	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
CNS-2	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3
LS2.C	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7
CCC-7	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | **Driving Question** *How can we protect biodiversity in rain forest ecosystems?*		
3-LS4-4 Biological Evolution: Unity and Diversity Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change **SEP-7** Engaging in Argument from Evidence Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem **LS2.C** Ecosystem Dynamics, Functioning, and Resilience When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die **LS4.D** Biodiversity and Humans Populations live in a variety of habitats, and change in those habitats affects the organisms living there **ETS1.B** Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved **CCC-7** Stability and Change Change is measured in terms of differences over time and may occur at different rates **CETAS-2** Influence of Engineering, Science, and Technology on Society and the Natural World People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies **CNS-8** Science Addresses Questions About the Natural and Material World Science findings are limited to questions that can be answered with empirical evidence	**MS-LS2-5** Ecosystems: Interactions, Energy, and Dynamics Evaluate competing design solutions for maintaining biodiversity and ecosystem services **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria **LS2.C** Ecosystem Dynamics, Functioning, and Resilience Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health **LS4.D** Biodiversity and Humans Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling (secondary) **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem (secondary) **CCC-7** Stability and Change Small changes in one part of a system might cause large changes in another part **CETAS-2** Influence of Engineering, Science, and Technology on Society and the Natural World The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time **CNS-8** Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes	**HS-LS2-7** Ecosystems: Interactions, Energy, and Dynamics Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations) **LS2.C** Ecosystem Dynamics, Functioning, and Resilience A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability **LS4.D** Biodiversity and Humans Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction) **ETS1.B** Developing Possible Solutions When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts **CCC-7** Stability and Change Systems can be designed for greater or lesser stability **CETAS-2** Influence of Engineering, Science, and Technology on Society and the Natural World New technologies can have deep impacts on society and the environment, including some that were not anticipated **CNS-8** Science Addresses Questions About the Natural and Material World Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS2-5 *Ecosystems: Interactions, Energy, and Dynamics*			
SEP-7	Lesson 3 Session 1	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
LS2.C	NA	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 5	Lesson 3 Session 6
LS4.D	NA	Lesson 3 Session 1 Lesson 3 Session 4	Lesson 3 Session 6
ETS1.B	NA	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
CCC-7	NA	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 5 Lesson 3 Session 6
CETAS-2[b]	NA	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4	Lesson 3 Session 6
CNS-8	NA	Lesson 3 Session 2	Lesson 3 Session 3

[b] Students learn extensively about the uses of technologies and limitations on their use, including those driven by differences in climate, in the The Heat Is On module.

The Green Monster Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we design a solution to minimize the effects of algal blooms at Lake Erie?*		
3–5-ETS1-1 Engineering Design Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost **SEP-1** Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost **ETS1.A** Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands **3–5-ETS1-2** Engineering Design Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost **SEP-7** Engaging in Argument from Evidence Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem **ETS1.B** Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions	**MS-ETS1-1** Engineering Design 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 **SEP-1** Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions **ETS1.A** Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions **MS-ETS1-2** Engineering Design Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem	**HS-ETS1-1** Engineering Design Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants **SEP-1** Asking Questions and Defining Problems Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations **ETS1.A** Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World Modern civilization depends on major technological systems, such as agriculture, health, water, energy, transportation, manufacturing, construction, and communications Engineers continuously modify these systems to increase benefits while decreasing costs and risks **HS-ETS1-2** Engineering Design Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations) **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics and to consider social, cultural and environmental impacts

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ETS1-1 *Engineering Design*			
SEP-1	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 10
ETS1.A	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 10
CETAS-2	NA	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 8 Lesson 1 Session 10
MS-ETS1-2 *Engineering Design*			
SEP-7	Lesson 1 Session 4	Lesson 1 Session 6	Lesson 1 Session 9 Lesson 1 Session 10
ETS1.B	NA	Lesson 1 Session 3 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10

[a] The role of different climate and economic conditions in the use of technologies is fully mastered in the The Bees' Needs module.

Grade 8 Suggested Scope and Sequence

	MODULE	STEAM ROLE STORYLINE	PERFORMANCE EXPECTATIONS	NGSS			
				Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Environmental Principles and Concepts
VOLUME 9	**Ocean Powered**	Students take on the role of engineering advisers, researching, developing, and testing Ocean Energy Converter (OEC) devices that use powerful ocean forces to transfer energy and generate electricity.	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-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.	SEP-2, SEP-3, SEP-4, SEP-6, SEP-7, SEP-8, CNS-2, CNS-4	CCC-1, CCC-2, CCC-3, CCC-4, CCC-5, CCC-6, CCC-7, CNS-8	PS2.A, PS3.A, PS3.B, PS3.C, ETS1.A, ETS1.B, ETS1.C	Principle II, Principle III, Principle IV, Principle V
	Asteroid Alert!	What are the odds of an asteroid striking the Earth? Could the Moon ever fall out of the sky? Students look to the Solar System to find out, exploring the characteristics of space objects and the threats they pose.	MS-ESS1-1 Develop and use a model of the Earth-Sun-Moon system to describe the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons. MS-ESS1-2 Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS-ESS1-3 Analyze and interpret data to determine scale properties of objects in the solar system. 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. MS-PS2-4* Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS-PS2-5* Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.	SEP-2, SEP-4, SEP-6, SEP-8	CCC-1, CCC-2, CCC-3, CCC-4, CNS-6, CETAS-1	PS2.B, ESS1.A, ESS1.B, ESS1.C	
VOLUME 10	**Collision Course**	What happens when two players collide? Students study sports injuries to understand the science behind collisions, using models and analyzing data to design customized helmets that minimize the risk of concussions and keep athletes safe.	MS-PS2-1 Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. 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-ETS1-4 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. 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-ETS1-3* 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-LS1-3* Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	SEP-1, SEP-2, SEP-4, SEP-6, SEP-7	CCC-1, CCC-2, CCC-4, CCC-5, CCC-6, CETAS-2	PS2.A, LS1.A, ETS1.A, ETS1.B, ETS1.C	
	Movie Magic	Lights, camera, action! Students work as science advisers with a movie production company, designing hoverboards, modeling football on Mars, and crafting the perfect stunt fall—creating movie magic that's rooted in real-world physics.	MS-PS2-3 Ask questions about data to determine the factors that affect the strength of electrical and magnetic forces. MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects. MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. 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-ESS1-2* Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system. MS-ESS1-3* Analyze and interpret data to determine scale properties of objects in the solar system.	SEP-1, SEP-2, SEP-3, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8, CNS-2	CCC-1, CCC-2, CCC-4, CCC-6, CCC-7	PS2.B, PS3.A, PS3.C, ESS1.B	

*Supporting PEs

NGSS STANDARDS KEY

SCIENCE AND ENGINEERING PRACTICES

SEP-1 Asking Questions and Defining Problems
SEP-2 Developing and Using Models
SEP-3 Planning and Carrying Out Investigations
SEP-4 Analyzing and Interpreting Data
SEP-5 Using Mathematics and Computational Thinking
SEP-6 Constructing Explanations and Designing Solutions
SEP-7 Engaging in Argument from Evidence
SEP-8 Obtaining, Evaluating, and Communicating Information

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-1 Scientific Investigations Use a Variety of Methods
CNS-2 Scientific Knowledge is Based on Empirical Evidence
CNS-3 Scientific Knowledge is Open to Revision in Light of New Evidence
CNS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

CROSSCUTTING CONCEPTS

CCC-1 Patterns
CCC-2 Cause and Effect
CCC-3 Scale, Proportion, and Quantity
CCC-4 Systems and System Models
CCC-5 Energy and Matter
CCC-6 Structure and Function
CCC-7 Stability and Change

CONNECTIONS TO ENGINEERING,TECHNOLOGY, AND APPLICATIONS OF SCIENCE

CETAS-1 Interdependence of Science, Engineering, and Technology
CETAS-2 Influence of Engineering, Technology, and Science on Society and the Natural World

CONNECTIONS TO THE NATURE OF SCIENCE

CNS-5 Science is a Way of Knowing
CNS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems
CNS-7 Science is a Human Endeavor
CNS-8 Science Addresses Questions About the Natural and Material World

DISCIPLINARY CORE IDEAS

PS1.A Structure and Properties of Matter
PS1.B Chemical Reactions
PS2.A Forces and Motion
PS2.B Types of Interactions
PS3.A Definitions of Energy
PS3.B Conservation of Energy and Energy Transfer
PS3.C Relationship between Energy and Forces
PS3.D Energy in Chemical Processes and Everyday Life
PS4.A Wave Properties
PS4.B Electromagnetic Radiation
PS4.C Information Technologies and Instrumentation

ETS1.A Defining and Delimiting Engineering Problems
ETS1.B Developing Possible Solutions
ETS1.C Optimizing the Design Solution

ESS1.A The Universe and Its Stars
ESS1.B Earth and the Solar System
ESS1.C The History of Planet Earth
ESS2.A Earth's Materials and Systems
ESS2.B Plate Tectonics and Large-Scale System Interactions
ESS2.C The Roles of Water in Earth's Surface Processes
ESS2.D Weather and Climate
ESS3.A Natural Resources
ESS3.B Natural Hazards
ESS3.C Human Impacts on Earth Systems
ESS3.D Global Climate Change

LS1.A Structure and Function
LS1.B Growth and Development of Organisms
LS1.C Organization for Matter and Energy Flow in Organisms
LS1.D Information Processing
LS2.A Interdependent Relationships in Ecosystems
LS2.B Cycles of Matter and Energy Transfer in Ecosystems
LS2.C Ecosystem Dynamics, Functioning, and Resilience
LS3.A Inheritance of Traits
LS3.B Variation of Traits
LS4.A Evidence of Common Ancestry and Diversity
LS4.B Natural Selection
LS4.C Adaptation
LS4.D Biodiversity and Humans

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

Principle I People Depend on Natural Systems
Principle II People Influence Natural Systems
Principle III Natural Systems Change in Ways that People Benefit From and Can Influence
Principle IV There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

Grade 8 Suggested Scope and Sequence

	MODULE	STEAM ROLE STORYLINE	PERFORMANCE EXPECTATIONS
VOLUME 11	Are They Among Us?	Students investigate the rich and complex history of life on Earth as they uncover evidence in the fossil record and analyze organisms to determine their ancient relatives.	MS-LS4-1 Analyze and interpret data for patterns in the fossil record that documents 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. 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. 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. 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. 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.
	Survival Stories	Students explore how we humans have survived in the face of the challenges presented by the world around us, using genetics as a lens to tell stories from our past and explore the possibilities of our future.	MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. 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. MS-LS4-5 Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. 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. 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-LS1-1* Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. MS-LS1-5* Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. MS-LS3-2* Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
VOLUME 12	Amazon of the Oceans	Students analyze the impacts of population growth, resource use, and human activity on the environment as they explore the biodiverse Coral Triangle. They create a social media campaign to help protect this important environment.	MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems. MS-LS2-4* Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. MS-ESS3-3* Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
	Into the Abyss	Over 80% of our oceans are unmapped. Students discover how waves can be used to learn more about the ocean, and plan a submarine expedition into the abyss to reveal the secrets of the sea using sonar techniques.	MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. 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.
	Animal Tracks	Wildlife monitoring is essential for understanding animal movement patterns and populations. Working alongside wildlife ecologists, students investigate how data can be transmitted between different monitoring devices and determine which approaches provide the most accurate data.	MS-PS4-3 Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals. 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. MS-ETS1-2* Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
	The Bees' Needs	Students work as ecosystem engineers to create microhabitats for honeybees. They identify the criteria and constraints of a successful beehive design, develop 2-D models, and iterate 3-D models.	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-ETS1-3 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-ETS1-2* Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. 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. MS-LS2-1* Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-4* Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

NGSS

Science and Engineering Practices	Crosscutting Concepts	Disciplinary Core Ideas	Environmental Principles and Concepts
SEP-1, SEP-2, SEP-4, SEP-6, SEP-8, CNS-2	CCC-1, CCC-3, CNS-6	LS4.A, LS4.B, ESS1.C	
SEP-2, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8	CCC-1, CCC-2, CCC-3, CCC-6, CCC-7, CNS-8, CETAS-1	LS1.A, LS1.B, LS3.A, LS3.B, LS4.B, LS4.C, EST1.A, ETS1.B	
SEP-2, SEP-4, SEP-5, SEP-7, SEP-8	CCC-2, CCC-5, CCC-7, CNS-5, CNS-8, CETAS-2	LS2.B, LS2.C, ESS3.C	Principle I, Principle II, Principle III, Principle IV, Principle V
SEP-1, SEP-2, SEP-3, SEP-4, SEP-5, SEP-6, SEP-7, SEP-8, CNS-2	CCC-1, CCC-2, CCC-5, CCC-6	PS4.A, PS4.B, LS4.B, LS4.C	Principle III
SEP-1, SEP-2, SEP-3, SEP-4, SEP-5, SEP-8, CNS-3	CCC-1, CCC-2, CCC-3, CCC-6, CCC-7, CNS-7, CETAS-2	PS4.C, LS1.B, ETS1.B	Principle II, Principle III, Principle IV, Principle V
SEP-1, SEP-2, SEP-4, SEP-6, SEP-7	CCC-2, CETAS-2	LS2.A, LS2.C, ETS1.A, ETS1.B, ETS1.C	Principle I, Principle II, Principle III, Principle IV, Principle V

*Supporting PEs

NGSS STANDARDS KEY

SCIENCE AND ENGINEERING PRACTICES

- SEP-1 Asking Questions and Defining Problems
- SEP-2 Developing and Using Models
- SEP-3 Planning and Carrying Out Investigations
- SEP-4 Analyzing and Interpreting Data
- SEP-5 Using Mathematics and Computational Thinking
- SEP-6 Constructing Explanations and Designing Solutions
- SEP-7 Engaging in Argument from Evidence
- SEP-8 Obtaining, Evaluating, and Communicating Information

CONNECTIONS TO THE NATURE OF SCIENCE

- CNS-1 Scientific Investigations Use a Variety of Methods
- CNS-2 Scientific Knowledge is Based on Empirical Evidence
- CNS-3 Scientific Knowledge is Open to Revision in Light of New Evidence
- CNS-4 Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena

CROSSCUTTING CONCEPTS

- CCC-1 Patterns
- CCC-2 Cause and Effect
- CCC-3 Scale, Proportion, and Quantity
- CCC-4 Systems and System Models
- CCC-5 Energy and Matter
- CCC-6 Structure and Function
- CCC-7 Stability and Change

CONNECTIONS TO ENGINEERING,TECHNOLOGY, AND APPLICATIONS OF SCIENCE

- CETAS-1 Interdependence of Science, Engineering, and Technology
- CETAS-2 Influence of Engineering, Technology, and Science on Society and the Natural World

CONNECTIONS TO THE NATURE OF SCIENCE

- CNS-5 Science is a Way of Knowing
- CNS-6 Scientific Knowledge Assumes an Order and Consistency in Natural Systems
- CNS-7 Science is a Human Endeavor
- CNS-8 Science Addresses Questions About the Natural and Material World

DISCIPLINARY CORE IDEAS

- PS1.A Structure and Properties of Matter
- PS1.B Chemical Reactions
- PS2.A Forces and Motion
- PS2.B Types of Interactions
- PS3.A Definitions of Energy
- PS3.B Conservation of Energy and Energy Transfer
- PS3.C Relationship between Energy and Forces
- PS3.D Energy in Chemical Processes and Everyday Life
- PS4.A Wave Properties
- PS4.B Electromagnetic Radiation
- PS4.C Information Technologies and Instrumentation

- ETS1.A Defining and Delimiting Engineering Problems
- ETS1.B Developing Possible Solutions
- ETS1.C Optimizing the Design Solution

- ESS1.A The Universe and Its Stars
- ESS1.B Earth and the Solar System
- ESS1.C The History of Planet Earth
- ESS2.A Earth's Materials and Systems
- ESS2.B Plate Tectonics and Large-Scale System Interactions
- ESS2.C The Roles of Water in Earth's Surface Processes
- ESS2.D Weather and Climate
- ESS3.A Natural Resources
- ESS3.B Natural Hazards
- ESS3.C Human Impacts on Earth Systems
- ESS3.D Global Climate Change

- LS1.A Structure and Function
- LS1.B Growth and Development of Organisms
- LS1.C Organization for Matter and Energy Flow in Organisms
- LS1.D Information Processing
- LS2.A Interdependent Relationships in Ecosystems
- LS2.B Cycles of Matter and Energy Transfer in Ecosystems
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS3.A Inheritance of Traits
- LS3.B Variation of Traits
- LS4.A Evidence of Common Ancestry and Diversity
- LS4.B Natural Selection
- LS4.C Adaptation
- LS4.D Biodiversity and Humans

ENVIRONMENTAL PRINCIPLES AND CONCEPTS

- Principle I People Depend on Natural Systems
- Principle II People Influence Natural Systems
- Principle III Natural Systems Change in Ways that People Benefit From and Can Influence
- Principle IV There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems
- Principle V Decisions Affecting Resources and Natural Systems are Complex and Involve Many Factors

Ocean Powered Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *What variables can affect a water turbine's motion? Lesson 3 | Driving Question How can we build a better OEC device to produce more electricity?*		
3-PS2-1 Motion and Stability: Forces and Interactions Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object **SEP-3** Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Scientific findings are based on recognizing patterns **PS2.A** Forces and Motion Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it **CCC-7** Stability and Change Change is measured in terms of differences over time and may occur at different rates. Some systems appear stable, but over long periods of time will eventually change	**MS-PS2-2** Motion and Stability: Forces and Interactions 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 **SEP-3** Planning and Carrying Out Investigations Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations **PS2.A** Forces and Motion The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared **CCC-7** Stability and Change Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales	**HS-PS2-1** Motion and Stability: Forces and Interactions 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 **SEP-3** Planning and Carrying Out Investigations Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science knowledge is based on empirical evidence **PS2.A** Forces and Motion Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object. In any system, total momentum is always conserved If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system **CCC-7** Stability and Change Much of science deals with constructing explanations of how things change and how they remain stable

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery	
MS-PS2-2 *Motion and Stability: Forces and Interactions*				
SEP-3	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 7
PS2.A	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 7
CCC-7	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6 Lesson 3 Session 7
CNS-2	NA	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 3 Session 1 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 7

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How can moving water be used to generate electricity?*		
4-PS3-1 Energy Use evidence to construct an explanation relating the speed of an object to the energy of that object **SEP-4** Analyze and Interpret Data Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computation **PS3.A** Definitions of Energy The faster a given object is moving, the more energy it possesses **CCC-3** Scale, Proportion, and Quantity Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume	**MS-PS3-1** Energy 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 **SEP-4** Analyze and Interpret Data Construct and interpret graphical displays of data to identify linear and nonlinear relationships **PS3.A** Definitions of Energy Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed **CCC-3** Scale, Proportion, and Quantity Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes	**HS-PS3-1** Energy 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 **SEP-4** Analyze and Interpret Data Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible **PS3.A** Definitions of Energy Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms **CCC-3** Scale, Proportion, and Quantity Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth)

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS3-1 *Energy*			
SEP.4	Lesson 2 Session 2 Lesson 2 Session 4	Lesson 2 Session 3 Lesson 2 Session 5	Lesson 2 Session 6
PS3.A	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5 Lesson 2 Session 6
CC.3	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5 Lesson 2 Session 6

Asteroid Alert! Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How do celestial objects differ from each other?*		
5-ESS1-2 Earth's Place in the Universe Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky **SEP-4** Analyzing and Interpreting Data Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings **ESS1.B** Earth and the Solar System The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year **CCC-3** Scale, Proportion, and Quantity Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods **CETAS-1** Interdependence of Science, Engineering, and Technology Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies **4-ESS1-1** Earth's Place in the Universe Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time **SEP-6** Constructing Explanations and Designing Solutions Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem **ESS1.C** The History of Planet Earth Local, regional, and global patterns of rock formations reveal changes over time due to earth forces, such as earthquakes. The presence and location of certain fossil types indicate the order in which rock layers were formed **CCC-3** Scale, Proportion, and Quantity Natural objects and/or observable phenomena exist from the very small to the immensely large or from very short to very long time periods	**MS-ESS1-3** Earth's Place in the Universe Analyze and interpret data to determine scale properties of objects in the solar system **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings **ESS1.B** Earth and the Solar System The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them **CCC-3** Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small **CETAS-1** Interdependence of Science, Engineering, and Technology Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems **MS-ESS1-4** Earth's Place in the Universe 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 **SEP-6** Constructing Explanations and Designing Solutions Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **ESS1.C** The History of Planet Earth The geologic time scale interpreted from rock strata provides a way to organize Earth's history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale **CCC-3** Scale, Proportion, and Quantity Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small	**HS-ESS1-4** Earth's Place in the Universe Use mathematical or computational representations to predict the motion of orbiting objects in the solar system **SEP-4** Analyzing and Interpreting Data Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations **ESS1.B** Earth and the Solar System Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system **CCC-3** Scale, Proportion, and Quantity Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly **CETAS-1** Interdependence of Science, Engineering, and Technology Science and engineering complement each other in the cycle known as research and development (R&D) **HS-ESS1-6** Earth's Place in the Universe 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 **SEP-6** Constructing Explanations and Designing Solutions Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future **ESS1.C** The History of Planet Earth Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history **CCC-3** Scale, Proportion, and Quantity Some systems can only be studied indirectly as they are too small, too large, too fast, or too slow to observe directly

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS1-3 *Earth's Place in the Universe*			
SEP.4	NA	Lesson 1 Session 2	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6
ESS1.B[a]	Lesson 1 Session 1	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	NA
CCC-3	NA	Lesson 1 Session 1	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6
CETAS-1[b]	NA	Lesson 1 Session 3	NA
MS-ESS1-4 *Earth's Place in the Universe*			
SEP.6	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 6
ESS1.C	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 6
CCC-3	NA	Lesson 1 Session 1	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6

[b] ESS1.B is fully mastered in Lesson 2 of this module as part of MS-ESS1-2.

[a] In this module, students understand that engineering advances have led to important scientific discoveries. They gained additional understanding about the interdependence of science and engineering in the Under the Microscope module.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How can we explain the motion of objects in the Universe?*		
5-ESS1-1 Earth's Place in the Universe Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **ESS1.A** The Universe and Its Stars The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth. **ESS1.B** Earth and the Solar System The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year **CCC-1** Patterns Patterns of change can be used to make predictions **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems **5-ESS1-2** Earth's Place in the Universe Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **ESS1.A** The Universe and Its Stars The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth **ESS1.B** Earth and the Solar System The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year **CCC-4** Systems and System Models A system can be described in terms of its components and their interactions **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems	**MS-ESS1-1** Earth's Place in the Universe Develop and use a model of the Earth sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **ESS1.A** The Universe and Its Stars Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models **ESS1.B** Earth and the Solar System This model of the solar system can explain eclipses of the sun and the moon. Earth's spin axis is fixed in direction over the short-term but tilted relative to its orbit around the sun. The seasons are a result of that tilt and are caused by the differential intensity of sunlight on different areas of Earth across the year **CCC-1** Patterns Patterns can be used to identify cause and-effect relationships **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation **MS-ESS1-2** Earth's Place in the Universe Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **ESS1.A** The Universe and Its Stars Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe **ESS1.B** Earth and the Solar System The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them The solar system appears to have formed from a disk of dust and gas, drawn together by gravity **CCC-4** Systems and System Models Models can be used to represent systems and their interactions **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation	**HS-ESS1-1** Earth's Place in the Universe 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 in the form of radiation **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **ESS1.A** The Universe and Its Stars The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years **ESS1.B** Earth and the Solar System Cyclical changes in the shape of Earth's orbit around the sun, together with changes in the tilt of the planet's axis of rotation, both occurring over hundreds of thousands of years, have altered the intensity and distribution of sunlight falling on the earth. These phenomena cause a cycle of ice ages and other gradual climate changes **CCC-1** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes the universe is a vast single system in which basic laws are consistent **HS-ESS1-2** Earth's Place in the Universe 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 **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **ESS1.A** The Universe and Its Stars The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe **ESS1.B** Earth and the Solar System Kepler's laws describe common features of the motions of orbiting objects, including their elliptical paths around the sun. Orbits may change due to the gravitational effects from, or collisions with, other objects in the solar system **CCC-4** Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes the universe is a vast single system in which basic laws are consistent

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS1-1 *Earth's Place in the Universe*			
SEP-2	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
ESS1.A	NA	Lesson 1 Session 1 Lesson 2 Session 4	Lesson 2 Session 8 Lesson 2 Session 9
ESS1.B	NA	Lesson 2 Session 5 Lesson 2 Session 6	Lesson 2 Session 7 Lesson 2 Session 8
CCC-2	NA	Lesson 2 Session 4	Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
CNS-6	NA	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7	Lesson 2 Session 8 Lesson 2 Session 9
MS-ESS1-2 *Earth's Place in the Universe*			
SEP-2	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
ESS1.A	NA	NA	Lesson 2 Session 3
ESS1.B	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 9
CCC-4	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9

Collision Course Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can engineers design helmets to help protect athletes?*		
3-PS2-1 Motion and Stability: Forces and Interactions Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas to solve design problems **PS2.A** Forces and Motion Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion **CCC-4** Systems and System Models A system can be described in terms of its components and their interactions **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands **3-5-ETS1-2** Engineering Design Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem **SEP-7** Engaging in Argument from Evidence Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem **ETS1.B** Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions **3-5-ETS1-3** Engineering Design Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved **SEP-2** Developing and Using Models Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system **ETS1.B** Developing Possible Solutions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved **ETS1.C** Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints	**MS-PS2-1** Motion and Stability: Forces and Interactions Apply Newton's third law to design a solution to a problem involving the motion of two colliding objects **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas or principles to design an object, tool, process or system **PS2.A** Forces and Motion For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law) **CCC-4** Systems and System Models Models can be used to represent systems and their interactions – such as inputs, processes and outputs-and energy and matter flows within systems **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions **MS-ETS1-2** Engineering Design Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions based on jointly developed and agreed-upon design criteria **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem **MS-ETS1-4** Engineering Design 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 **SEP-2** Developing and Using Models Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs **ETS1.B** Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it Models of all kinds are important for testing solutions **ETS1.C** Optimizing the Design Solution The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement, and ultimately to an optimal solution	**HS-PS2-1** Motion and Stability: Forces and Interactions Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a microscopic object, its mass, and its acceleration **SEP-6** Constructing Explanations and Designing Solutions Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student generated sources of evidence, prioritized criteria, and tradeoff considerations **PS2.A** Forces and Motion If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system **CCC-4** Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks **HS-ETS1-2** Engineering Design Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g., economic, societal, environmental, ethical considerations) **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts **HS-ETS1-4** Engineering Design 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 **SEP-2** Developing and Using Models Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/ or solve problems **ETS1.B** Developing Possible Solutions Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs **ETS1.C** Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS2-1 *Motion and Stability: Forces and Interactions*			
SEP-6	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9
PS2.A	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9
CCC-4	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9
CETAS-2[a]	NA	Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
MS-ETS1-2 *Engineering Design*			
SEP.7[b]	NA	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.B	NA	Lesson 1 Session 5	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9
MS-ETS1-4 *Engineering Design*			
SEP.2	NA	Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8
ETS1.B	NA	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9
ETS1.C	NA	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8	Lesson 1 Session 9

[a] The role of desires and values in technology use and the impact of factors like climate, natural resources, and economic conditions are fully mastered across the CreATe Network, Turtle SOS, The Green Monster, and The Bees' Needs modules.

[b] In this module, students evaluate competing design solutions based on provided criteria. They evaluate solutions based on jointly developed and agreed-upon design criteria in the The Green Monster module.

Movie Magic Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we make something defy the effects of gravity?*		
3-PS2-3 Motion and Stability: Forces and Interactions Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other **SEP-3** Planning and Carrying Out Investigations Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered **PS2.B** Types of Interactions Electric and magnetic forces between a pair of objects do not require that the objects be in contact. The sizes of the forces in each situation depend on the properties of the objects and their distances apart and, for forces between two magnets, on their orientation relative to each other **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change **3-PS2-3** Motion and Stability: Forces and Interactions Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other **SEP-1** Asking Questions and Defining Problems Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships **PS2.B** Types of Interactions Objects in contact exert forces on each other **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change	**MS-PS2-5** Motion and Stability: Forces and Interactions Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact **SEP-3** Planning and Carrying Out Investigations Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation **PS2.B** Types of Interactions Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively) **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems **MS-PS2-3** Motion and Stability: Forces and Interactions Ask questions about data to determine the factors that affect the strength of electric and magnetic forces **SEP-1** Asking Questions and Defining Problems Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles **PS2.B** Types of Interactions Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems	**HS-PS2-5** Motion and Stability: Forces and Interactions Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current **SEP-3** Planning and Carrying Out Investigations Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible variables or effects and evaluate the confounding investigation's design to ensure variables are controlled **PS2.B** Types of Interactions Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system **HS-PS2-4** Motion and Stability: Forces and Interactions Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects **SEP-1** Asking Questions and Defining Problems Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory **PS2.B** Types of Interactions Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS2-5 *Motion and Stability: Forces and Interactions*			
SEP-3	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 10
PS2.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CCC-2	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
MS-PS2-3 *Motion and Stability: Forces and Interactions*			
SEP-1	Lesson 1 Session 1	Lesson 1 Session 3 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
PS2.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 10
CCC-2	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 6 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *Can we replicate the effects of gravity on other planets?*		
5-PS2-1 Motion and Stability: Forces and Interactions Support an argument that the gravitational force exerted by Earth on objects is directed down **SEP-7** Engaging in Argument from Evidence Construct and/or support an argument with evidence, data, and/or a model **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science findings are based on recognizing patterns **PS2.B** Types of Interactions The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center **CCC-4** Systems and System Models A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot	**MS-PS2-4** Motion and Stability: Forces and Interactions Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects **SEP-7** Engaging in Argument from Evidence Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations **PS2.B** Types of Interactions Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the Sun **CCC-4** Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems	**HS-PS2-4** Motion and Stability: Forces and Interactions Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects **SEP-7** Engaging in Argument from Evidence Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science includes the process of coordinating patterns of evidence with current theory **PS2.B** Types of Interactions Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects **CCC-4** Systems and System Models Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS2-4 *Motion and Stability: Forces and Interactions*			
SEP-7	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5
CNS-2	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 5
PS2.B	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5
CCC-4	NA	Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | **Driving Question** *What affects a stuntperson's fall?*		
4-PS3-3 Energy Ask questions and predict outcomes about the changes in energy that occur when objects collide **SEP-2** Developing and Using Models Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system **PS3.A** Definitions of Energy The faster a given object is moving, the more energy it possesses **PS3.C** Relationship Between Energy and Forces When objects collide, the contact forces transfer energy so as to change the objects motions **CCC-4** Systems and System Models Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume	**MS-PS3-2** Energy 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 **SEP-2** Developing and Using Models Develop a model to describe unobservable mechanisms **PS3.A** Definitions of Energy A system of objects may also contain stored (potential) energy, depending on their relative positions **PS3.C** Relationship Between Energy and Forces When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object **CCC-4** Systems and System Models Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy and matter flows within systems	**HS-PS3-2** Energy Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects) **SEP-2** Developing and Using Models Use a model to provide mechanistic accounts of phenomena **PS3.A** Definitions of Energy Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms **PS3.C** Relationship Between Energy and Forces When two objects interacting through a field change relative position, the energy stored in the field is changed **CCC-4** Systems and System Models Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth **vs.** exponential growth)

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS3-2 *Energy*			
SEP-2	NA	Lesson 3 Session 1 Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
PS3.A	NA	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
PS3.C	NA	Lesson 3 Session 1	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5
CCC-4	NA	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5

Are They Among Us? Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *What can fossils tell us about how life has changed over time?*		
3-LS4-3 Biological Evolution: Unity and Diversity Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to make sense of phenomena using logical reasoning, mathematics, and/or computation **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science findings are based on recognizing patterns **LS4.A** Evidence of Common Ancestry and Diversity Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments **CCC-1** Patterns Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems	**MS-LS4-1** Biological Evolution: Unity and Diversity 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 **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to find similarities and differences in findings **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science knowledge is based upon logical and conceptual connections between evidence and explanations **LS4.A** Evidence of Common Ancestry and Diversity The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth **CCC-1** Patterns Graphs, charts, and images can be used to identify patterns in data **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation	**HS-LS4-2** Biological Evolution: Unity and Diversity Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment **SEP-4** Analyzing and Interpreting Data Evaluate the impact of new data on a working explanation and/or model of a proposed process or system **CNS-2** Scientific Knowledge Is Based on Empirical Evidence Science arguments are strengthened by multiple lines of evidence supporting a single explanation **LS4.A** Evidence of Common Ancestry and Diversity Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence **CCC-1** Patterns Empirical evidence is needed to identify patterns **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS4-1 *Biological Evolution: Unity and Diversity*			
SEP-4	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 6
CNS-2	NA	Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6
LS4.A	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6
CCC-1	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 6
CNS-6	NA	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 6

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | **Driving Question** *How can we determine relationships between organisms?*		
3-LS4-2 Biological Evolution: Unity and Diversity Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing **SEP-4** Analyzing and Interpreting Data Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships **LS4.A** Evidence of Common Ancestry and Diversity Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments **CCC-1** Patterns Similarities and differences in patterns can be used to sort, classify, communicate and analyze simple rates of change for natural phenomena and designed products **3-LS4-1** Biological Evolution: Unity and Diversity Analyze and interpret data from fossils to provide evidence of the organisms and the environments in which they lived long ago **SEP-6** Constructing Explanations and Designing Solutions Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard) **LS4.A** Evidence of Common Ancestry and Diversity Some kinds of plants and animals that once lived on Earth are no longer found anywhere **CCC-1** Patterns Patterns can be used as evidence to support an explanation **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes consistent patterns in natural systems	**MS-LS4-3** Biological Evolution: Unity and Diversity 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 **SEP-4** Analyzing and Interpreting Data Analyze displays of data to identify linear and nonlinear relationships **LS4.A** Evidence of Common Ancestry and Diversity Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully formed anatomy **CCC-1** Patterns Graphs, charts, and images can be used to identify patterns in data **MS-LS4-2** Biological Evolution: Unity and Diversity 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 **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events **LS4.A** Evidence of Common Ancestry and Diversity Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent **CCC-1** Patterns Patterns can be used to identify cause and effect relationships **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Science assumes that objects and events in natural systems occur in consistent patterns that are understandable through measurement and observation	**HS-LS4-1** Biological Evolution: Unity and Diversity Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence **SEP-4** Analyzing and Interpreting Data Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations **LS4.A** Evidence of Common Ancestry and Diversity Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence **CCC-1** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena **HS-LS4-4** Biological Evolution: Unity and Diversity Construct an explanation based on evidence for how natural selection leads to adaptation of populations **SEP-6** Constructing Explanations and Designing Solutions Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects **LS4.A** Evidence of Common Ancestry and Diversity Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence **CCC-1** Patterns Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena **CNS-6** Scientific Knowledge Assumes an Order and Consistency in Natural Systems Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS4-3 *Biological Evolution: Unity and Diversity*			
SEP-4	NA	Lesson 2 Session 5	Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 9
LS4.A	NA	Lesson 2 Session 5	Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
CCC-1	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 6 Lesson 2 Session 7 Lesson 2 Session 9
MS-LS4-2 *Biological Evolution: Unity and Diversity*			
SEP-6	NA	Lesson 2 Session 4	Lesson 2 Session 6 Lesson 2 Session 9
LS4.A	NA	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 7 Lesson 2 Session 9
CCC-1	NA	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 7 Lesson 2 Session 8 Lesson 2 Session 9
CNS-6	NA	Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 8 Lesson 2 Session 9

Survival Stories Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | **Driving Question** *What causes traits in a population to change?* **Lesson 2** | **Driving Question** *How do genes change?*		
3-LS4-4 Biological Evolution: Unity and Diversity Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing **SEP-6** Constructing Explanations and Designing Solutions Construct an explanation of observed relationships (e.g., the distribution of plants in the back yard) **LS4.B** Natural Selection Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change	**MS-LS4-4** Biological Evolution: Unity and Diversity 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 **SEP-6** Constructing Explanations and Designing Solutions Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena **LS4.B** Natural Selection Natural selection leads to the predominance of certain traits in a population, and the suppression of others **CCC-2** Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability	**HS-LS4-4** Biological Evolution: Unity and Diversity Construct an explanation based on evidence for how natural selection leads to adaptation of populations **SEP-6** Constructing Explanations and Designing Solutions Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables **LS4.B** Natural Selection The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS4-4 *Biological Evolution: Unity and Diversity*			
SEP-6	Lesson 1 Session 1 Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5
LS4.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 2 Session 2 Lesson 2 Session 3	Lesson 2 Session 4 Lesson 2 Session 5
CCC-2	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4	Lesson 1 Session 5 Lesson 2 Session 1 Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How do genes change?*		
3-LS4-4 Biological Evolution: Unity and Diversity Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change **SEP-5** Using Mathematics and Computational Thinking Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems **LS4.C** Adaptation For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change	**MS-LS4-6** Biological Evolution: Unity and Diversity Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time **SEP-5** Using Mathematics and Computational Thinking Use mathematical representations to support scientific conclusions and design solutions **LS4.C** Adaptation Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes **CCC-2** Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability	**HS-LS4-6** Biological Evolution: Unity and Diversity Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity **SEP-5** Using Mathematics and Computational Thinking Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations **LS4.C** Adaptation Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS4-6 *Biological Evolution: Unity and Diversity*			
SEP-5	NA	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5
LS4.C	NA	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5
CCC-2	Lesson 2 Session 1 Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 3 | Driving Question *What makes some people more resistant to diseases?*		
3-LS3-1 Heredity: Inheritance and Variation of Traits Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms **SEP-2** Developing and Using Models Develop and/or use models to describe and/or predict phenomena **LS3.A** Inheritance of Traits Many characteristics of organisms are inherited from their parents **LS3.B** Variation of Traits Different organisms vary in how they look and function because they have different inherited information **CCC-6** Structure and Function Substructures have shapes and parts that serve functions	**MS-LS3-1** Heredity: Inheritance and Variation of Traits Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **LS3.A** Inheritance of Traits Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits **LS3.B** Variation of Traits In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism **CCC-6** Structure and Function Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function	**HS-LS3-1** Heredity: Inheritance and Variation of Traits Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors **SEP-2** Developing and Using Models Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations **LS3.A** Inheritance of Traits Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function **LS3.B** Variation of Traits In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited **CCC-6** Structure and Function The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS3-1 *Heredity: Inheritance and Variation of Traits*			
SEP-2	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4	Lesson 3 Session 5
LS3.A[a]	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4	Lesson 3 Session 5
LS3.B[b]	Lesson 3 Session 1	Lesson 3 Session 2 Lesson 3 Session 3	Lesson 3 Session 4 Lesson 3 Session 5
CCC-6	Lesson 3 Session 1	Lesson 3 Session 2	Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5

[a] How genetic variation results from sexual reproduction is mastered in the North Island Rescue module.

[b] The relationship between DNA, genes, alleles, and chromosomes is mastered in the North Island Rescue module.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 4 | Driving Question *How can technology help our survival?*		
3-LS4-4 Biological Evolution: Unity and Diversity Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change **SEP-8** Obtaining, Evaluating, and Communicating Information Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence **LS4.B** Natural Selection Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change **CETAS-1** Interdependence of Science, Engineering, and Technology Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies **CNS-8** Science Addresses Questions About the Natural and Material World Science findings are limited to questions that can be answered with empirical evidence	**MS-LS4-5** Biological Evolution: Unity and Diversity Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms **SEP-8** Obtaining, Evaluating, and Communicating Information Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence **LS4.B** Natural Selection In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring **CCC-2** Cause and Effect Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability **CETAS-1** Interdependence of Science, Engineering, and Technology Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems **CNS-8** Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes	**HS-LS4-5** Biological Evolution: Unity and Diversity Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species **SEP-8** Obtaining, Evaluating, and Communicating Information Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible **LS4.B** Natural Selection Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals **CCC-2** Cause and Effect Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system **CETAS-1** Interdependence of Science, Engineering, and Technology Science and engineering complement each other in the cycle known as research and development (R&D) **CNS-8** Science Addresses Questions About the Natural and Material World Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-LS4-5 *Biological Evolution: Unity and Diversity*			
SEP-8	Lesson 4 Session 1	Lesson 4 Session 2	Lesson 4 Session 3 Lesson 4 Session 4 Lesson 4 Session 5
LS4.B	NA	Lesson 4 Session 1 Lesson 4 Session 2	Lesson 4 Session 3 Lesson 4 Session 4 Lesson 4 Session 5
CCC-2	NA	Lesson 4 Session 1 Lesson 4 Session 2 Lesson 4 Session 3 Lesson 4 Session 4	Lesson 4 Session 5
CETAS-1[c]	NA	Lesson 4 Session 1 Lesson 4 Session 2	Lesson 4 Session 3 Lesson 4 Session 5
CNS-8[d]	NA	Lesson 4 Session 2 Lesson 4 Session 3	Lesson 4 Session 4 Lesson 4 Session 5

[c] Students also consider how engineering advances lead to important discoveries in the Under the Microscope, The Plastic Tide, and Asteroid Alert! modules.

[d] Students also consider how scientific knowledge does not necessarily prescribe societal decisions in the A Place Called Home and Amazon of the Oceans modules.

Amazon of the Oceans Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *What effect is increased tourism having on the environment in the Coral Triangle, and farther afield?*		
5-ESS3-1 Earth and Human Activity Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment **SEP-7** Engaging in Argument from Evidence Construct and/or support an argument with evidence, data, and/or a model **ESS3.C** Human Impacts on Earth Systems Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments **CCC-2** Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies **CNS-8** Science Addresses Questions About the Natural and Material World Science findings are limited to questions that can be answered with empirical evidence	**MS-ESS3-4** Earth and Human Activity Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems **SEP-7** Engaging in Argument from Evidence Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem **ESS3.C** Human Impacts on Earth Systems Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise **CCC-2** Cause and Effect Cause and effect relationships may be used to predict phenomena in natural or designed systems **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment **CNS-8** Science Addresses Questions About the Natural and Material World Scientific knowledge can describe the consequences of actions but does not necessarily prescribe the decisions that society takes	**HS-ESS3-4** Earth and Human Activity Evaluate or refine a technological solution that reduces impacts of human activities on natural systems **SEP-7** Engaging in Argument from Evidence Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and logical arguments regarding relevant factors (e.g. economic, societal, environmental, ethical considerations) **ESS3.C** Human Impacts on Earth Systems The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources **CCC-2** Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks **CNS-8** Science Addresses Questions About the Natural and Material World Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ESS3-4 *Earth and Human Activity*			
SEP-7	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 8	Lesson 1 Session 9 Lesson 1 Session 10
ESS3.C	Lesson 1 Session 1 Lesson 1 Session 6	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CCC-2	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CETAS-2	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10
CNS-8	Lesson 1 Session 4	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 10

Into the Abyss Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | **Driving Question** *Why is it dark in the deep ocean?* **Lesson 3** | **Driving Question** *How can we map the deep ocean?*		
4-PS4-2 Waves and their Applications in Technologies for Information Transfer Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen **SEP-2** Developing and Using Models Develop a model to describe phenomena **PS4.A** Wave Properties Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. (Note: This grade band endpoint was moved from K–2.) Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks) **PS4.B** Electromagnetic Radiation An object can be seen when light reflected from its surface enters the eyes **CCC-6** Structure and Function Different materials have different substructures, which can sometimes be observed	**MS-PS4-2** Waves and their Applications in Technologies for Information Transfer Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials **SEP-2** Developing and Using Models Develop and use a model to describe phenomena **PS4.A** Wave Properties A sound wave needs a medium through which it is transmitted **PS4.B** Electromagnetic Radiation When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. However, because light can travel through space, it cannot be a matter wave, like sound or water waves **CCC-6** Structure and Function Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used	**HS-PS4-2** Waves and their Applications in Technologies for Information Transfer Evaluate questions about the advantages of using a digital transmission and storage of information **SEP-2** Developing and Using Models Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system **PS4.A** Wave Properties Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses **PS4.B** Electromagnetic Radiation Electromagnetic radiation (e.g., radio, microwaves, light) can be modeled as a wave of changing electric and magnetic fields or as particles called photons. The wave model is useful for explaining many features of electromagnetic radiation, and the particle model explains other features **CCC-6** Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS4-2 *Waves and Their Applications in Technologies for Information Transfer*			
SEP-2	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
PS4.A	Lesson 1 Session 1	Lesson 1 Session 6 Lesson 1 Session 7	Lesson 3 Session 1 Lesson 3 Session 2 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6
PS4.B	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6	Lesson 1 Session 7 Lesson 3 Session 1 Lesson 3 Session 6
CCC-6	Lesson 1 Session 1	Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 3 Session 3 Lesson 3 Session 4 Lesson 3 Session 5 Lesson 3 Session 6

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 2 | Driving Question *How can we study organisms in the deep ocean?*		
4-PS4-1 Waves and their Applications in Technologies for Information Transfer Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move **SEP-5** Using Mathematics and Computational Thinking Describe, measure, estimate, and/or graph quantities such as area, volume, weight, and time to address scientific and engineering questions and problems **PS4.A** Wave Properties Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach. Waves of the same type can differ in amplitude (height of the wave) and wavelength (spacing between wave peaks) **CCC-1** Patterns Similarities and differences in patterns can be used to sort and classify natural phenomena	**MS-PS4-1** Waves and their Applications in Technologies for Information Transfer Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave **SEP-5** Using Mathematics and Computational Thinking Use mathematical representations to describe and/or support scientific conclusions and design solutions **PS4.A** Wave Properties A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude **CCC-1** Patterns Graphs, charts, and images can be used to identify patterns in data	**HS-PS4-1** Waves and their Applications in Technologies for Information Transfer Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media **SEP-5** Using Mathematics and Computational Thinking Use mathematical representations of phenomena or design solutions to describe and/or support claims and/or explanations **PS4.A** Wave Properties The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing **CCC-1** Patterns Empirical evidence is needed to identify patterns

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS4-1 *Waves and Their Applications in Technologies for Information Transfer*			
SEP-5	Lesson 2 Session 1	Lesson 2 Session 2 Lesson 2 Session 3 Lesson 2 Session 4	Lesson 2 Session 5 Lesson 2 Session 7
PS4.A	Lesson 2 Session 1	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 7
CCC-1	Lesson 2 Session 1	Lesson 2 Session 2	Lesson 2 Session 3 Lesson 2 Session 4 Lesson 2 Session 5 Lesson 2 Session 7

Animal Tracks Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How do different technologies transmit information about animals?*		
4-PS4-3 Waves and their Applications in Technologies for Information Transfer Generate and compare multiple solutions that use patterns to transfer information **SEP-8** Obtaining, Evaluating, and Communicating Information Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence **PS4.C** Information Technologies and Instrumentation Digitized information can be transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa **CCC-6** Structure and Function Different materials have different substructures, which can sometimes be observed **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands **CNS-7** Science is a Human Endeavor Science affects everyday life	**MS-PS4-3** Waves and their Applications in Technologies for Information Transfer Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals **SEP-8** Obtaining, Evaluating, and Communicating Information Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims and findings **PS4.C** Information Technologies and Instrumentation Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information **CCC-6** Structure and Function Structures can be designed to serve particular functions **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations **CNS-7** Science is a Human Endeavor Advances in technology influence the progress of science and science has influenced advances in technology	**HS-PS4-2** Waves and their Applications in Technologies for Information Transfer Evaluate questions about the advantages of using digital transmission and storage of information **SEP-8** Obtaining, Evaluating, and Communicating Information Compare, integrate, and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem **PS4.C** Information Technologies and Instrumentation Multiple technologies based on the understanding of waves and their interactions with matter are part of everyday experiences in the modern world (e.g., medical imaging, communications, scanners) and in scientific research. They are essential tools for producing, transmitting, and capturing signals and for storing and interpreting the information contained in them **CCC-6** Structure and Function Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem **CETAS-2** Influence of Science, Engineering, and Technology on Society and the Natural World Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks **CNS-7** Science is a Human Endeavor Technological advances have influenced the progress of science and science has influenced advances in technology

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-PS4-3 *Waves and Their Applications in Technologies for Information Transfer*			
SEP-8	Lesson 1 Session 1 Lesson 1 Session 3	Lesson 1 Session 2 Lesson 1 Session 4	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
PS4.C	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CCC-6	Lesson 1 Session 1	Lesson 1 Session 4	Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 9 Lesson 1 Session 10
CETAS-2	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CNS-7	NA	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10

The Bees' Needs Performance Expectation Progressions

To meet the module Performance Expectations, students build on knowledge, skills, and practices developed in elementary school and lay the foundations for those to come in high school.

Prior Knowledge (Grades 3–5)	Working Toward in Middle School (Grades 6–8)	Future Knowledge (Grades 9–12)
Lesson 1 | Driving Question *How can we design a beehive that protects the needs of honeybees and the communities that depend on them?*		
3-5-ETS1-1 Engineering Design Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost **SEP-1** Asking Questions and Defining Problems Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost **ETS1.A** Defining and Delimiting Engineering Problems Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World People's needs and wants change over time, as do their demands for new and improved technologies. Engineers improve existing technologies Engineers improve existing technologies or develop new ones to increase their benefits, to decrease known risks, and to meet societal demands **3-5-ETS1-3** Engineering Design Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved **SEP-4** Analyzing and Interpreting Data Analyze data to refine a problem statement or the design of a proposed object, tool, or process **ETS1.B** Developing Possible Solutions Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved **ETS1.C** Optimizing the Design Solution Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints	**MS-ETS1-1** Engineering Design 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 **SEP-1** Asking Questions and Defining Problems Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions **ETS1.A** Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions **MS-ETS1-3** Engineering Design 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 **SEP-4** Analyzing and Interpreting Data Analyze and interpret data to determine similarities and differences in findings **ETS1.B** Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors **ETS1.C** Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design	**HS-ETS1-1** Engineering Design Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants **SEP-1** Asking Questions and Defining Problems Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations **ETS1.A** Defining and Delimiting Engineering Problems Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them **CETAS-2** Influence of Engineering, Technology, and Science on Society and the Natural World Engineers continuously modify these systems to increase benefits while decreasing costs and risks. New technologies can have deep impacts on society and the environment, including some that were not anticipated Analysis of costs and benefits is a critical aspect of decisions about technology **HS-ETS1-3** Engineering Design Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts **SEP-4** Analyzing and Interpreting Data Evaluate the impact of new data on a working explanation and/or model of a proposed process or system **ETS1.B** Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs **ETS1.C** Optimizing the Design Solution Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed

	Working with Prior Knowledge	Working Toward Mastery	Demonstrating Mastery
MS-ETS1-1 *Engineering Design*			
SEP-1	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.A	NA	Lesson 1 Session 1	Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
CETAS-2[a]	Lesson 1 Session 1	Lesson 1 Session 2 Lesson 1 Session 3 Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 7	Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
MS-ETS1-3 *Engineering Design*			
SEP-4	Lesson 1 Session 1	Lesson 1 Session 2	Lesson 1 Session 4 Lesson 1 Session 5 Lesson 1 Session 6 Lesson 1 Session 8 Lesson 1 Session 10
ETS1.B	Lesson 1 Session 1 Lesson 1 Session 2 Lesson 1 Session 3	Lesson 1 Session 4 Lesson 1 Session 5	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10
ETS1.C	NA	Lesson 1 Session 4	Lesson 1 Session 6 Lesson 1 Session 7 Lesson 1 Session 8 Lesson 1 Session 9 Lesson 1 Session 10

[a] The short- and long-term consequences, positive as well as negative, of human activity are fully mastered in the The Green Monster module.

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