CHΔNGES Science Standards Legend: **E** = estuary module **S** = savanna module

Subject	MS CCRS for Science DCI	Conceptual Understanding	Standard	Performance Objectives	Activity/Lesson
Biology	BIO.5 Interdependence of Organisms and Their Environments	Complex interactions within an ecosystem affect the numbers and types of organisms that survive. Fluctuations in conditions can affect the ecosystem's function, resources, and habitat availability. Ecosystems are subject to carrying capacities and can only support a limited number of organisms and populations. Factors that can affect the carrying capacities of populations are both biotic and abiotic.	**BIO.5** Students will Investigate and evaluate the interdependence of living organisms and their environment.	**BIO.5.1** Illustrate levels of ecological hierarchy, including organism, population, community, ecosystem, biome, and biosphere.	**E**: Day 1- Structure, Day 2- plankton food web **S**: Day 1- Structure
				BIO.5.2 Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem.	**E**: Day 1 & 2- general mention of nutrient cycling, eutrophication **S**: n/a
				BIO.5.4 Develop and use models to describe the flow of energy and amount of biomass through food chains, food webs, and food pyramids.	**E**: Day 1- Biodiversity, Day – Plankton Food Web **S**: Day 1- Biodiversity
				BIO.5.6 Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems.	**E**: Day 2- Species Survey (Science in a Seine) **S**: Day 2- Species Survey (Narrowmouth Toad) and Drift Fence Activity
				BIO.5.7 Investigate and evaluate factors involved in primary and secondary ecological succession using local, real world examples.	**E**: n/a **S**: All days of the savanna module
				BIO.5.8 Enrichment: Use an engineering design process to create a solution that addresses changing ecological conditions (e.g., climate change, invasive species, loss of biodiversity, human population growth, habitat destruction, biomagnification, or natural phenomena).*	**E**: Day 5- Restoration Plan **S**: Day 5- Restoration Plan

*Engineering design process. See Page 12 in 2018 MS CCRS for Science.

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Botany	BOT.4 Society's Reliance on Plants	Human reliance on plants and plant products began with food and building materials. This use has expanded to include medicine, industrial clean up (phytoremediation) of human-generated byproducts and toxic waste, and plant examples used in biomimicry for solving human problems.	**BOT.4** Students will explore the global value of plants and the interaction between humans and plants.	**BOT.4.1** Identify plants used in the bioremediation of an area due to natural processes (e.g., fire), industrial pollution, or wars, and develop and communicate a plan to remediate a habitat impacted by human interactions (e.g., carbon sinks, phytoremediation, or heavy metal detoxification).	**E**: Day 1- Species Highlight salt marsh plants, Day 2- Restoration Practices, Day 3- field practice/data collection **S**: Day 1 all topics, Day 2- Restoration Practices, Day 3- field practice/data collection
				BOT.4.2 Enrichment: Use an engineering design process to define a problem, design, construct, evaluate, and improve a habitat impacted by human interactions.*	**E**: Day 5- Restoration Plan **S**: Day 5- Restoration Plan
				BOT.4.3 Investigate historical and modern medicinal uses of plants.	**E**: yaupon holly, toothache tree **S**: yaupon holly, toothache grass
				BOT.4.4 Investigate the industrial use of plants.	**E**: n/a **S**: Day 1 & Day 2- longleaf pine and slash pine timber industry
	BOT.5 Plant Adaptations to Varying Habitats	Before animal life forms can survive within a habitat, there must be an existing plant population. Plants have specific adaptations that allow them to survive in habitats.	**BOT.5** Students will explore adaptations that allow plants to survive in various habitats.	**BOT.5.1** Research plants found in various habitats. Analyze how plants use adaptations for survival in these habitats including extreme habitats.	**E**: native plants all days of estuary module **S**: native plants all days of savanna module
	BOT.6 Local Plant Investigations	The plant diversity within the local environment impacts the health of the ecosystem. The ability to identify the plants within an ecosystem is a skill that will benefit students throughout life.	**BOT.6** Students will ask questions, plan, and conduct field investigations on local plant communities.	**BOT.6.1** Conduct transects/plot studies to determine species, biodiversity, or health of a plant community. (Plots may be linear or a quadrat (square or circular) depending on the habitat. (Typically, relative density, relative dominance, and relative frequency of each species are calculated to infer an importance value of the species in the plot.)	**E**: Day 3- Field day **S**: Day 3- Field day, main activity

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Earth and Space Science	ESS.4 Earth's Resources and Human Activity	The dynamic Earth impacts human society. Natural hazards and other geologic events have shaped the course of human history. In addition, humans also impact the Earth through resource extraction and land use.	**ESS.4** Students will develop an understanding of Earth's resources and the impact of human activities.	**ESS.4.1** Research, evaluate, and communicate about how human life on Earth shapes Earth's systems and responds to the interaction of Earth's systems (e.g., geosphere, hydrosphere, atmosphere, and biosphere). Examine how geochemical and ecological processes interact through time to cycle matter and energy and how human activity alters the rates of these processes.	**E**: Day 2- Impacts Grid activity, eutrophication, fragmentation, erosion **S**: Day 2- Impacts Grid, fire suppression, resource extraction, land use
				ESS.4.2 Research, assess, and communicate how Earth's systems influence the distribution of life, including how various natural hazards and geologic events (e.g., volcanic eruptions, earthquakes, landslides, tornadoes, and hurricanes) have shaped the course of human history.	**E**: Day 2- Impacts Grid activity **S**: Day 2- Impacts Grid activity
Environmental Science	ENV.1 Biosphere and Biodiversity	The biosphere is a system of biomes, each with unique characteristics. These characteristics are classified as biotic or abiotic. The environment in which humans live is dependent on a system of cycles. These biogeochemical cycles are the water, nitrogen, carbon, and phosphorus cycles. The flow of energy within the environment is critical for the success of life. The biodiversity within a biome is fragile and easily affected by human actions. Plant and animal populations are dynamic and are demonstrated through graphical analysis.	**ENV.1** Students will investigate the interdependence of diverse living organisms and their interactions with the components of the biosphere.	**ENV.1.8** Utilize data to communicate changes within a given population and the environmental factors that may have impacted these changes (e.g., weather patterns, natural disasters).	**E**: Day 4- Data Comparison and Analysis **S**: Day 4- Data Comparison and Analysis
				ENV.1.9 Evaluate and communicate data that explains how human activity may impact biodiversity (e.g., introduction, removal, and reintroduction of an organism within an ecosystem; land usage) and genetic variations of organisms, including endangered and threatened species.	**E**: Day 4- Data Comparison and Analysis **S**: Day 4- Data Comparison and Analysis

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Environmental Science	ENV.2 Natural Resources Use and Conservation	The environment is affected by human demand for its resources. However, through conservation applications, a balance may be reached between human sustainability and the environment.	**ENV.2** Students will relate the impact of human activities on the environment, conservation activities, and efforts to maintain and restore ecosystems.	**ENV.2.5** Research various resources related to water quality and pollution (e.g., nonfictional text, EPA's Surf Your Watershed, MDEQ publications) and communicate the possible effects on the environment and human health.	**E**: Day 4- Data Comparison and Analysis **S**: n/a
				ENV.2.6 Enrichment: Obtain water from a local source (e.g., stream on campus, rainwater, ditch water) to monitor water quality over time, using a spreadsheet program to graphically represent collected data.	**E**: Day 3- Monitoring the Estuary, Day 4- Data Comparison and Analysis **S**: n/a
Foundations of Biology	FB.6 Ecological Principals	Ecosystems are dynamic in nature, full of complex interactions that affect the numbers and types of organisms that can survive. Biotic and abiotic factors affect ecosystems, allowing for them to sustain only a limited number of organisms and populations, known as a carrying capacity. There is a delicate balance that exists between the living and non-living things in an ecosystem. Humans can interrupt this balance, causing both local and global environmental issues.	**FB.6** Students will understand the interdependence of living organisms and their environment.	**FB.6.3** Obtain, evaluate, and communicate information to explain relationships that exist between abiotic and biotic components of an ecosystem. Explain how changes in biotic and abiotic components affect the balance of an ecosystem over time.	**E**: Day 1- Species Highlight salt marsh plants **S**: n/a
				FB 6.5 Use models to analyze the flow of energy through food chains, webs, and pyramids.	**E**: Day 2- Plankton Food Web **S**: n/a
				FB 6.7 Enrichment: Design solutions to reduce the impact of human activity on the ecosystem.	**E**: Day 5- Restoration Plan **S**: Day 5- Restoration Plan

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Foundations of Science Literacy	FSL.3 Nature of Science	Science is characterized by the systematic gathering of information through various forms of direct and indirect observations, and the testing of this information by methods including, but not limited to, experimentation. By formulating their own questions, planning, and conducting investigations, learners build new meaning, understanding, and knowledge of science. This helps develop their critical thinking, reasoning and decision-making skills that will serve a learner for a lifetime.	**FSL.3A** Students will apply science and engineering practices and skills to scientific investigations.	**FSL.3A.1** Ask questions and conduct research to generate a hypothesis, determine independent/dependent variables, and appropriate controls for scientific investigations and experiments.	**E**: n/a **S**: Supplemental Matchstick Savanna activity
				FSL.3A.2 Analyze data from simple experiments and construct organized models (e.g., data tables, graphs) detailing results from the experiments.	**E**: Day 4- Water Quality graphing **S**: Supplemental Matchstick Savanna activity
				FSL.3A.3 Demonstrate the proper use of safety procedures and scientific laboratory equipment. Select and use appropriate tools and instruments to collect qualitative and quantitative data.	**E**: Day 3- field day, all day **S**: Day 3- field day, all day
				FSL.3A.4 Use mathematical and computational thinking to (1) use and manipulate appropriate metric units, (2) express relationships between variables for investigations, and (3) compare or combine data from two or more simple data presentations (e.g., order or sum data from a table, categorize data from a table using a scale from another table).	**E**: Day 3- field day, all day, Day 4- Data Comparison and Analysis **S**: Day 3- field day, all day, Day 4- Data Comparison and Analysis
				FSL.3A.5 Analyze data sets from experiments for patterns and trends and identify any weaknesses in the experimental designs.	**E**: Day 4- Data Comparison and Analysis **S**: Day 4- Data Comparison and Analysis

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Foundations of Science Literacy	FSL.3 Nature of Science	Scientists interpret tables, graphs, and diagrams to locate data, examine relationships in the data, and extend those relationships beyond the data. Students should analyze scientific investigations and data presented in passages like those found in the science section of the ACT (e.g., Data Representation, Research Summaries, and Conflicting Viewpoint passages).	**FSL.3B** Students will apply scientific literacy and thinking skills to analyze and interpret data found in various graphics including, but not limited to, those found in sample ACT science passages.	**FSL.3B.1** Analyze select data from a simple and complex data presentation (e.g., charts, graphs, diagrams).	**E**: Day 2- Species Survey (Science in a Seine) **S**: Day 2- Species Survey (Narrowmouth Toad)
				FSL.3B.2 Compare or combine data from two or more simple data presentations (e.g., order or sum data from a table, categorize data from a table using a scale from another table, relationships between data sets).	**E**: Day 4- Data Comparison and Analysis **S**: Day 4- Data Comparison and Analysis
				FSL.3B.3 Translate information into a table, graph, or diagram. Determine patterns, trends, and relationships as the values of variables change.	**E**: Day 4- Data Comparison and Analysis **S**: Day 4- Data Comparison and Analysis
				FSL.3B.4 Perform a simple interpolation or simple extrapolation using data in a table or graph. Determine and/or use a simple (e.g., linear) mathematical relationship that exists between data.	**E**: Day 4- relationship among water quality parameters observed **S**: Day 4- Stand Density Index calculation
				FSL.3B.5 Analyze presented information when given new information (e.g., given a new scenario, how would a given scenario be changed).	**E**: Day 5- Restoration Plan **S**: Day 5- Restoration Plan

Subject	MS CCRS for Science DCI	Conceptual Understanding	Standard	Performance Objectives	Activity/Lesson
Foundations of Science Literacy	FSL.3 Nature of Science	Scientists understand experimental design and procedures, compare designs and procedures across experiments, and understand how changes in design and procedures affect experimental results.	**FSL.3C** Students will apply scientific literacy and thinking skills to analyze scientific investigations found in various experimental designs including, but not limited to, those found in sample ACT science passages.	**FSL.3C.1** Analyze the methods and choice of tools used in simple and complex experimental designs.	**E**: Day 2- Species Survey (Science in a Seine), Day 5- determining monitoring plan **S**: Day 2- Species Survey (Narrowmouth Toad), Day 5- determining monitoring plan
				FSL.3C.3 Select and describe an alternate method for testing a hypothesis.	**E**: n/a **S**: Day 2- Species Survey (Narrowmouth Toad)
				FSL.3C.4 Predict how modifying the experimental design or adding another measurement in an experimental design will affect results of the experiment.	**E**: Day 2- Restoration Practices **S**: Day 2- Percent Cover activity and discussion, Restoration Practices
				FSL.3C.5 Determine which additional trials could be performed in an investigation to enhance the results of an experimental design.	**E**: Day 2- Restoration Practices **S**: Day 2- Percent Cover activity and discussion, Restoration Practices
		Scientists evaluate multiple explanations for the same phenomena to determine their differences, similarities, strengths, and weaknesses, and evaluating the validity of conclusions based on experimental results. They evaluate the validity of conclusions based on experimental results.	**FSL.3D** Students will apply scientific literacy and thinking skills to evaluate theoretical models, inferences, and experimental results found in various experimental designs including, but not limited to, those found in sample ACT science passages.	**FSL.3D.2** Determine whether given information supports or contradicts a hypothesis or conclusion, and provide support for the reasoning.	**E**: Day 4- Data analysis discussion **S**: Day 4- Data analysis discussion
				FSL.3D.3 Analyze and interpret data from informational texts and data to (1) reveal patterns and construct meaning (2) support or refute hypotheses, explanations, claims or designs, or (3) evaluate the strength of conclusions.	**E**: Day 4- Data analysis discussion **S**: Day 4- Data analysis discussion

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Marine and Aquatic Science I	MAQ.1 Water Properties and Quality	Water is essential to all life on earth. The chemical and physical properties of water allow for all essential processes with biota. Analysis of water quality indicates ecosystem health and balance. Recycling of water throughout the biosphere allows for replenishment of fresh water, but contaminations by human activities are hindering the total amount of potable fresh water.	**MAQ.1** Students will develop an understanding of the unique physical and chemical properties of water and how those properties shape life on earth.	**MAQ.1.4** Collect, analyze, and communicate quantitative data that includes dissolved oxygen, pH, temperature, salinity, mineral content, nitrogen compounds, and turbidity from an aquatic environment (i.e., hydrometer, refractometer, Secchi disk, and chemical test kits).	**E**: Day 3- field day, all day **S**: n/a
	MAQ.4 Flora and Fauna	Unique flora and fauna can be found in different aquatic ecosystems. Their features and unique biochemistry may serve to further the human quality of life. However, human impacts and natural events have altered many of these ecosystems in different ways.	**MAQ.4** Students will examine characteristics of specific aquatic ecosystems and the effects of human and natural phenomena on those ecosystems.	**MAQ.4.1** Compare and contrast the unique biotic and abiotic characteristics of the following selected aquatic ecosystems: intertidal zone, **wetlands/estuaries**, coral reef, barrier islands, continental slope/shelf, abyss, rivers/streams/watersheds, and lakes/ponds.	**E**: Day 1- Introduction **S**: n/a
				MAQ.4.2 Recognize representative examples of plants and animals that would be specifically adapted to the aquatic ecosystems, and identify adaptations necessary to survive.	**E**: Day 1- Species Highlight, Day 2- Salt loving plants **S**: n/a
				MAQ.4.3 Determine the niches within trophic levels in the aquatic ecosystems by creating food webs and researching the symbiotic relationships that exist.	**E**: Day 2- Plankton Food Web **S**: n/a
				MAQ.4.4 Research, analyze, and communicate the effects of urbanization and continued expansion by humans on the aquatic ecosystems' biodiversity (e.g., land use changes, erosion and sedimentation, over-fishing, invasive/exotic species, and pollution).	**E**: Day 2- Impacts Grid activity, Day 5- Restoration Plan **S**: n/a

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Marine and Aquatic Science I	MAQ.4 Flora and Fauna	Unique flora and fauna can be found in different aquatic ecosystems. Their features and unique biochemistry may serve to further the human quality of life. However, human impacts and natural events have altered many of these ecosystems in different ways.	**MAQ.4** Students will examine characteristics of specific aquatic ecosystems and the effects of human and natural phenomena on those ecosystems.	**MAQ.4.5** Explore the importance of species diversity to the biological resources needed by human populations, including food (e.g., aquaculture and mariculture), medicine, and natural aesthetics.	**E**: Day 1- Ecosystem Services **S**: n/a for this standard, although we also talk about Ecosystem Services
				MAQ.4.6 Research, analyze, and communicate the effects of natural phenomena (e.g., hurricanes, floods, drought, and sea-level rise) on the aquatic ecosystems.	**E**: Day 2- Impacts Grid activity **S**: n/a
				MAQ.4.8 Enrichment: Choose an environmental issue that currently exists in one of the aquatic ecosystems and use an engineering design process to propose and develop a possible solution using scientific knowledge and best management practices (BMPs). Create an environmental action plan to include moral, legal, societal, political, and economic decisions that impact animal diversity in both the short and long term. Results from developed plans will be communicated with classmates.*	**E**: Day 5- Restoration Plan **S**: n/a
	MAQ.5 Primary Producers	Primary producers are the basis of every food web in aquatic ecosystems. While many producers are photosynthetic autotrophs, chemosynthesis is also a common form of energy conversion. Surveying shared and derived characteristics of producers demonstrates evolutionary development. Various methods are currently utilized to measure primary productivity in various ecosystems.	**MAQ.5** Students will explore the biodiversity and interactions among aquatic life.	**MAQ.5.2** List and describe common autotrophs that may be found in particular aquatic ecosystems, including prokaryotes (e.g., Cyanobacteria and Archaebacteria), protists (e.g., diatoms, dinoflagellates, green algae, kelp, sargassum, and red algae), and plants (e.g., cord grasses, reeds, seagrasses, and mangroves).	**E**: Day 1- Species Highlight, Day 2- Salt loving plants **S**: n/a

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Marine and Aquatic Science I	MAQ.7 Vertebrate Consumers	Other consumers that inhabit aquatic ecosystems are found within Phylum Chordata. While many of these consumers share basic morphological characteristics, derived characteristics demonstrate evolutionary relationships. Various adaptations are found among these organisms for successful niches within selected ecosystems.	**MAQ.7** Students will investigate characteristics of aquatic invertebrates.	**MAQ.7.1** Characterize aquatic representatives of the following taxa: Hemichordata, Urochordata, Cephalochordata, and Vertebrata (including Agnatha, Chondrichthyes, Osteichthyes, Amphibia, Reptilia, Aves, and Mammalia).	**E**: Day 2- Species Survey, Species Reference List **S**: n/a
Zoology I	ZOO.3 Phylum Mollusca	Phylum Mollusca is one of the most diverse phyla on earth, occupying almost every type of ecosystem. Despite its diversity, mollusks share a basic body plan and are well adapted to their niches within environments.	**ZOO.3** Students will understand the structure and function of phylum Mollusca, and how they adapt to their environments.	**ZOO.3.4** Describe how the radula is used in feeding.	**E**: Day 3- field day if there are periwinkles, Species Reference List **S**: n/a
	ZOO.5 Phylum Arthropoda	Arthropods are the most successful of animal phyla, inhabiting land, sea, and air. Despite their differences, all arthropods share some characteristics enabling them to be united as one phylum.	**ZOO.5** Students will understand the basic structure and function of phylum Arthropoda, and how they demonstrate the characteristics of living things.	**ZOO.5.2** Explain how the exoskeleton is used in locomotion, protection, and development.	**E**: Species Reference List **S**: n/a
				ZOO.5.4 Identify organisms and characteristics of chelicerates, crustaceans, and insects.	**E**: Species Reference List **S**: n/a
				ZOO.5.6 Describe the importance of chela for decapods, such as lobsters and crabs.	**E**: Species Reference List **S**: n/a

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Zoology II	Zoo.7 Phylum Chordata, Classes Chondrichthyes and Osteichthyes	Of the members of phylum Chordata, fish species are most numerous. These aquatic vertebrates have gills throughout their lives and either have or are descended from ancestors with scales or armor.	**ZOO.7** Students will understand the structure and function of phylum Chordata, classes Chondrichthyes and Osteichthyes, and how they demonstrate the characteristics of living things.	**ZOO.7.2** Compare and contrast the characteristics of class Chondrichthyes and Osteichthyes.	**E**: Applicable if we collect anything on our boat trip **S**: n/a
				ZOO.7.3 Identify specific fish species and characteristics that differentiate class Chondrichthyes (e.g., sharks, skates, and rays).	**E**: Applicable if we collect anything on our boat trip **S**: n/a
	ZOO.8 Phylum Chordata, Classes Amphibia and Reptilia	The two groups of ectothermic tetrapods—amphibians and reptiles—are similar in appearance, but differ drastically in development and body structure.	**ZOO.8** Students will understand the structure and function of phylum Chordata, classes Amphibia and Reptilia, and how they demonstrate the characteristics of living things.	**ZOO.8.2** Describe the constraints that require amphibians to spend part of their lives in water and part on land, including the morphological and physiological changes as they pass from one stage of their life cycle to the next.	**E**: Applicable if we collect anything on our boat trip, Species Reference List **S**: Applicable if we collect anything from our drift fence, Species Reference List
				ZOO.8.4 Define what it means to be ectothermic, and identify ways in which reptiles regulate their body temperature.	**E**: Applicable if we collect anything on our boat trip, Species Reference List **S**: Applicable if we collect anything from our drift fence, Species Reference List
				ZOO.8.5 Describe how snakes use chemosensory to locate and track prey.	**E**: Applicable if we collect anything on our boat trip, Species Reference List **S**: Applicable if we collect anything from our drift fence, Species Reference List

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Zoology II	ZOO.9 Phylum Chordata, Class Aves	Class Aves, including birds, are endothermic, egg-laying vertebrates with bodies covered in feathers. Although they are descendants of dinosaurs, they have evolved a unique physiology, making most capable of flight.	**ZOO.9** Students will understand the structure and function of phylum Chordata, class Aves, and how they demonstrate the characteristics of living things.	**ZOO. 9.5** Explain how birds of prey use their keen sense of sight to locate and attack prey.	**E**: Applicable if we see anything on our boat trip, Species Reference List **S**: Applicable if we see anything in the field, Species Reference List
				ZOO. 9.9 Demonstrate how different adaptations of the bird beak and feet allow them to feed and survive in different environments.	**E**: Applicable if we see anything on our boat trip **S**: Applicable if we see anything in the field
	ZOO.10 Phylum Chordata, Class Mammalia	Class Mammalia consists of endothermic organisms with hair, a four-chambered heart, a diaphragm, and mammary glands. As inhabitants of every continent, they are successful in a great variety of ecosystems.	**ZOO.10** Students will understand the structure and function of phylum Chordata, class Mammalia, and how they demonstrate the characteristics of living things.	**ZOO 10.6** Explain how human impacts have changed the environment of aquatic and terrestrial organisms (e.g., habitat destruction, urbanization, and climate change).	**E**: Applicable if we see anything on our boat trip **S**: Applicable if we see anything in the field

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