Next Generation Science Standards Alignment

The game-based leaning curriculum presented here was developed to build data literacy, engaging students in increasingly sophisticated modes of understanding and manipulation of data. This document outlines the ways in which each level of the module provides learning experiences that engage students in the three dimensions of the NGSS Framework while building towards competency in targeted performance expectations. This document identifies the specific practice, core idea and concept directly associated with a performance expectation (shown in parentheses in the tables) but also includes additional practices and concepts that can help students build toward a standard.

Performance Expectations – Middle School
Earth and Human Activity NGSS MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. Addressed By Students understand that rapid increases in atmospheric CO_2 have caused oceans to become more acidic and threaten marine ecosystems, and they test and evaluate decisions/methods to help reduce OA impacts on the environment.
Ecosystems: Interactions, Energy, and Dynamics NGSS MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. Addressed By Students analyze quantitative results from game-based curriculum to show that coral reefs populations decrease with increasing OA, and that changes to coral also affects populations of other species such as fish and humans. NGSS MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services. Addressed By Students manipulate and discuss decisions to help reduce OA impacts on coral and coastal ecosystems, which have high biodiversity that is threatened by increasing OA.

Science and Engineering Practices (SEPs)	Middle School SEP	How the SEP is Addressed by the Module
Construction Explanations and Designing Solutions	Apply scientific principles to design an object, tool, process, or system. (MS-ESS3-3)	Students apply increasing levels of knowledge to test how decisions change marine systems and OA outcomes.
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. (MS-LS2-4) Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-LS2-5)	Students can have the option in the classroom to discuss and perhaps write summaries of their decisions to support ways to minimize OA effects on marine systems and people. Students evaluate and manipulate decisions that have varying means to reduce effects of OA.
Scientific Knowledge is Based on Empirical Evidence	Science disciplines share common rules of obtaining and evaluating empirical evidence. (MS-LS2-4)	Students visualize progress throughout their decision process and analyze how empirical outcomes can help inform future decisions.

Disciplinary Core Ideas (DCIs)	Middle School DCI	How the DCI is Addressed by the Module
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. (MS-ESS3-3) 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. (MS-ESS3-3), (MS-ESS3-4)	Students analyze quantitative results from game-based curriculum to show that coral reefs populations decrease with increasing OA, and that changes to coral also affects populations of other species such as fish and humans. Students view that as OA will increase and harm marine systems and people unless certain decisions are assessed and applied to help prevent these negative effects.
LS2.C: Ecosystems 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. (MS-LS2-4) 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. (MS-LS2-5)	Students understand that rapid increases in atmospheric CO_2 have caused oceans to become more acidic and threaten marine ecosystems in cascading ways. Students analyze and evaluate that biodiversity in marine systems decreases with decreasing ocean health due to harmful OA.
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 to MS-LS2-5)	Students analyze quantitative results to show that important marine life such as coral reefs decrease with increasing OA, and that changes to these systems affects species that rely on those groups, such as fish and humans.
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 to MS-LS2-5)	Students analyze and assess multiple decisions in a cascading framework to evaluate best decisions to reducing the problem of OA.

Cross Cutting Concepts (CCCs)	Middle School CCC	How the CCC is Addressed by the Module
Cause and Effect	Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. (MS-ESS3-3)	Students learn that increasing CO_2 is a causal mechanism for increasing OA.
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. (MS-ESS3-2), (MS-ESS3-3), (MS-LS2-5)	Students will analyze and evaluate and decisions to reduce OA in various marine regions with different characters. This variation allows students to evaluate how different decisions lead to possibly varying outcomes in different marine regions.
Stability and Change	Small changes in one part of a system might cause large changes in another part. (MS-LS2-4), (MS-LS2-5)	Students assess and analyze that changes and decisions to one section of the marine system can have cascading effects to other sections of the system.
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. (MS-LS2-5)	Knowledge that students gain through the curriculum can inform their decisions to help reduce OA as much as possible, though the real word decisions made by society my be different.