Madison Public Schools

Marine Science and Technology - Unit 1 Science - Ecosystems

Unit Focus

In this unit, coastal ecology will be explored including, the rocky shore, sandy shore, estuaries, and salt marsh. Interdisciplinary projects will also be incorporated to widen the student's understanding of maritime-based careers and life. Students will work to identify problems, conduct scientific studies, analyze data and offer solutions to help improve our local ecology. Field studies on each marine ecosystem will be done to support student understanding of the concepts in this unit. Units like this one, where students use their hands, help them build confidence and problem-solving skills useful for life's experiences.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science
High School Life Sciences: 9 - 12

- Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem. *HS-LS2-6*

Next Generation Science Standards (DCI)
Science: 10

- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities. *ETS1.9.A2*
- 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. *LS2.9.A1*
- 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

Transfer

T1 Make observations and ask questions to define a problem based on prior knowledge and curiosity that stimulates further exploration, analysis, and discovery.
T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.
T3 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.

Meaning

Understanding(s)	Essential Question(s)
U1 Ecosystems are complex, interdependent systems are ever changing **U2** The cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the physical environment. **U3** If a biological or physical disturbance to an ecosystem occurs, including one induced by human activity, the ecosystem may return to its more or less original state or become a very different ecosystem, depending on the complex set of interactions within the ecosystem.	**Q1** How and why do organisms interact with their environment and what are the effects of these interactions? **Q2** How do environmental changes affect abiotic and biotic factors in an ecosystem?

Acquisition of Knowledge and Skill

Knowledge	Skill(s)
K1 Ecology is the scientific study of interactions among organisms and between organisms and their environment,	**S1** Analyzing an environmental issue using scientific data.

Stage 1: Desired Results - Key Understandings

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. *LS2.9.C1*

- Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions, and the decline-and sometimes the extinction-of some species. *LS4.9.C4*
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value. *LS4.9.D2*

NGSS/NSTA Science & Engineering Practices

NGSS Science & Engineering Practices: 9-12

- Select appropriate tools to collect, record, analyze, and evaluate data. *SE.9-12.3.4*

Student Growth and Development 21st Century Capacities Matrix

Critical Thinking

- Synthesizing: Students will be able to thoughtfully combine information/data/evidence, concepts, texts, and disciplines to draw conclusions, create solutions, and/or verify generalizations for a given purpose. *MM.1.3*

Collaboration/Communication

- Product Creation: Students will be able to effectively use a medium to communicate important information (findings, ideas, feelings, issues, etc.) for a given purpose. *MM.3.2*

or surroundings.

K2 Sustaining life requires substantial energy and matter inputs.

K3 As matter and energy flow through different organizational levels—cells, tissues, organs, organisms, populations, communities, and ecosystems—of living systems, chemical elements are recombined in different ways to form different products.

K4 Ecosystems include both biological communities (biotic) and physical (abiotic) components of the environment.

K5 Seeking matter and energy resources to sustain life, organisms in an ecosystem interact with one another in complex feeding hierarchies of producers, consumers, and decomposers, which together represent a food web.

K6 Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment.

K7 Ecosystems have carrying capacities that limit the number of organisms (within populations) they can support.

K8 Ecosystems are sustained by the continuous flow of energy, originating primarily from the sun, and the recycling of matter and nutrients within the system.

K9 Ecosystems are dynamic, experiencing shifts in population composition and abundance and changes in the physical environment over time, which ultimately affects the stability and resilience of the entire system.

K10 Ecosystems are ever changing because of the interdependence of organisms of the same or different species and the nonliving (physical) elements of the environment.

K11 Within any one ecosystem, the biotic interactions between organisms (e.g., competition, predation, and various types of facilitation, such as pollination) further influence their growth, survival, and reproduction, both individually and in terms of their populations.

S2 Developing and using models to explain systems or processes.