**HS-LS2 Ecosystems: Interactions, Energy, and Dynamics**

**HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.**

Further Explanation: Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets. Examples could include a look at historical data of the population of a species that has moved north into Maine, such as opossum, and how it has changed as the climate in Maine has changed. Observe data of the populations of harbor seals and the effect that a hunting ban has had on their population and the resulting increase in the number of large predatory sharks in the Gulf of Maine.

Using Mathematics and Computational Thinking, Interdependent Relationships in Ecosystems, Scale, Proportion, and Quantity

**HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.**

Further explanation: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. Examples could include a graphical analysis of historical data on the population of trout and/or landlocked salmon before and after the introduction of bass into Moosehead Lake. Or data on a variety of populations (biodiversity) affected by dredging for sea scallops.

Using Mathematics and Computational Thinking, Interdependent Relationships in Ecosystems, Scale, Proportion, and Quantity

**HS-LS2-3 Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.**

Further explanation: Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments. An example could include a classroom lab activity around a Winogradsky Column with groups changing a variable such as temperature or light. Additional examples could look at the fermentation processes when blue-green algae is grown in aerobic and anaerobic environments.

Constructing Explanations and Designing Solutions, Cycles of Matter and Energy Transfer in Ecosystems, Energy and Matter

**HS-LS2-4 Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.**

Further Explanation: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem. An example could include an illustration of a food pyramid students may find in Maine (e.g. seaweed 🡪 snail 🡪 fish 🡪 shark, or grass 🡪 insects 🡪 turkeys 🡪 foxes).

Using Mathematics and Computational Thinking, Cycles of Matter and Energy Transfer in Ecosystems, Energy and Matter

**HS-LS2-5 Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.**

Further explanation: Examples of models could include simulations and mathematical models. Models may include multi-media illustration of the carbon cycle to include a Maine ecosystem they are familiar with such as pond, seaside, farm, forest, etc.

Developing and Using Models, Cycles of Matter and Energy Transfer, Energy in Chemical Processes, Systems and System Models

**HS-LS2-6 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.**

Further explanation: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise. Examples could include how the number of moose hunting licenses impacts other populations or how fishing limits or shortened seasons decreases the catch of many fish species and the effects on ground fish or smaller fish.

Engaging in Argument from Evidence, Ecosystem Dynamics, Functioning, and Resilience, Stability and Change

**HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.**

Further explanation: Examples of human activities can include urbanization, building dams, and dissemination of invasive species. Potential Maine connections include the effects of: salting the roads in winter, introducing green crabs into coastal waters, introducing invasive species into Maine lakes, or examining historical data on water pollution in the Androscoggin during the height of mill activity, closing of mills and legislation on water quality.

Constructing Explanations and Designing Solutions, Ecosystem Dynamics, Functioning, and Resilience, Biodiversity and Humans, Developing Possible Solutions, Stability and Change

**HS-LS2-8 Evaluate the evidence for the role of group behavior on individual and species’ chances to survive and reproduce.**

Further explanation: Emphasis is on: (1) distinguishing between group and individual behavior, (2) identifying evidence supporting the outcomes of group behavior, and (3) developing logical and reasonable arguments based on evidence. Examples of group behaviors could include flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming. Examples could include turkeys flocking to evade hunters or Canada geese migrating to and through Maine for breeding purposes.

Engaging in Argument from Evidence, Social Interactions and Group Behavior, Cause and Effect