Unit 7 | Ecosystems & Invasive Species

Living Environment | **20-28 days**

Energy flows and matter cycles among organisms, and between organisms and their environment, creating dynamic interconnected systems. In this unit, students learn about the biotic and abiotic factors in a river ecosystem, using the Hudson River as a case study. They then investigate the impact of an invasive species (zebra mussels) on this ecosystem, using teaching case materials created by scientists at the American Museum of Natural History. Students then make hypotheses about how the presence of zebra mussels might affect a specific biotic or abiotic factor.Finally, using data collected by the Cary Institute, students write scientific explanations confirming or rejecting their hypotheses, thus building an understanding of the role of data and collaboration in the scientific community.

In what ways are organisms and their environment interdependent? How can altered ecosystems recover to a point of long-term stability?

UNIT STORYLINE SNAPSHOT

Anchor Phenomenon: Zebra Mussel Invasion

In what ways are organisms and their environment interdependent? How can altered ecosystems recover to a point of long-term stability?

Performance Task: Hudson River Ecology

Components of a Stable Ecosystem

5E Instructional Model Plan

Population Dynamics

3E Instructional Model Plan

Ecosystem Disruption & Recovery ***5E Instructional Model Plan***	**Invasive Species** ***5E Instructional Model Plan***

PLANNING RESOURCES

- Knowledge and Enduring Understandings
- Storyline and Pacing Guide
- Common Core Standards
- NY State Regents Exam Readiness
- NY State Science Standards
- Unit Vocabulary

KNOWLEDGE AND ENDURING UNDERSTANDINGS

Knowledge: (Students will know. . .)	Enduring Understandings

High priority content - required ● Components of ecosystem ● Interdependence of species (Std. 4, Key Idea 1 - PI 1.1) ● Cycles of matter and energy transformations (Std. 4, Key Idea 6 - PI 6.1) ● Relationships between species and their environment ● Ecological succession (Std. 4, Key Idea 6 - PI 6.2, 6.3)	**Mid-priority content - recommended** ● Dynamic equilibrium ● Respiration and photosynthesis (Std. 4, Key Idea 5 - PI 5.1) ● Characteristics of life ● Cell Theory (Std. 4, Key Idea 1 - PI 1.2, 1.3)	● Ecosystems are made up of living and nonliving things that interact in complex ways. ● A single change to an ecosystem can affect all different parts of that ecosystem. Eventually, the ecosystem will get to a new equilibrium.

✦Storyline and Pacing Guide

	Time	Teacher Resource	Driving Questions	What students figure out *Ideas that contribute to student thinking about the anchor phenomenon and performance task*
Launch Anchor Phenomenon	**1 Days**	Link	*How are new species introduced into existing ecosystems?*	● Humans purposefully and accidently move organisms from one ecosystem to another ● The rate at which species are introduced to new areas is increasing with global travel

	**Introduce Performance Task**	**1 Day**	Link	*How can we determine the impacts on the Hudson River ecosystem of the zebra mussel introduction?*	• Some new species do not become established, others do • The zebra mussel was introduced to the Hudson River ecosystem • Scientists have been monitoring the river ecosystem before and after the introduction
	**Stable Ecosystems**	**5-8 Days**	5E Plan	*How do biotic and abiotic factors interact in an ecosystem?* *How can we model the interconnectedness of biotic and abiotic factors in an ecosystem?* *How can we understand the different types of relationships between organisms?*	• Ecosystems are complex, dynamic systems composed of living and non living things that constantly interact • Changes in living things impact non-living components, and vice versa -- in other words, all components of an ecosystem are interdependent • Food chains demonstrate feeding relationships between organisms • Food webs demonstrate all of the interacting food chains in an ecosystem • Organisms may be in a feeding relationship, compete, or be in a symbiotic relationship
	**Population Dynamics**	**5-8 Days**	5E Plan	*How do populations of predator and prey interact?* *How do predator populations impact the stability of an ecosystem?*	• Predator and prey are interdependent • Predator populations maintain prey populations -- as prey increase, food sources may decrease, resulting in starvation • Predators help maintain stability by limiting prey populations, preventing overexploitation of vegetation

Return to the performance task and engage students in revising their initial response to the cladogram task and their reasoning, based on the new evidence and ideas generated in the Stable Ecosystems and Population Dynamics instructional sequences.

Revisit the **Unit Driving Question Board** - are there questions that have been addressed in these instructional sequences? -- have new questions been brought to the forefront?

	Ecosystem Disruption & Recovery	**5-8 Days**	5E Plan	*How do ecosystems respond after disturbances?* *Why is biodiversity an important component of ecosystem resilience?*	• Ecological succession is a process in which an ecosystem returns to a climax community after a disturbance • Complex food webs maintain stability, and facilitate faster recovery of an ecosystem after a disturbance
	Return to the performance task and engage students in revising their initial response to the cladogram task and their reasoning, based on the new evidence and ideas generated in the Ecosystem Disruption and Recovery instructional sequence. Revisit the **Unit Driving Question Board** - are there questions that have been addressed in these instructional sequences? -- have new questions been brought to the forefront?				
	Invasive Species	**5-8 Days**	5E Plan	*Why do some introduced species become invasive?* *How do invasive species impact an ecosystem?* *How do ecosystems regain stability after an invasive species?*	• Not all introduced species become invasive • Introduced species may become invasive if they are not held in check by predators, disease, or competition • Over time, complex ecosystems may regain stability after any disturbance, including an invasive species
	Complete Culminating Task	**1 Day**	Link	*How did the introduction of the zebra mussel impact the Hudson River ecosystem?*	• In the short term, the zebra mussel introduction … • In the long term, the zebra mussel introduction ...

✦NY State Regents Exam Readiness

Regents Topics (from 1996 standards)	Historical Coverage (over the last 5 administrations of LE Regents)[1]	More Details *How is this addressed in the unit?*
Individual & Population Growth	6.4%	Population dynamics 5E plan addresses this topic directly. These ideas are also addressed in the Invasive species 5E and the Hudson River Ecosystem performance task.
Ecosystem Stability	5%	Addressed throughout the unit
Environmental Change	4%	Addressed in the Ecosystem disruption & recovery 5E plan
	Unit 7 Regents Item Bank	

New York State Science Standards

NY State MST Standards (1996) *This unit was designed to address the following NY State 1996 Standards.*	**NYSSLS (2017)** *As designed, this unit works towards the following NYSSLS Performance Expectations, with partial alignment.*
Key Idea 1: Living things are both similar to and different from each other and from nonliving things PI 1.1 - Explain how diversity of populations within	**HS-LS2-6.** Evaluate 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.

[1] Regents Tool; Awesome table

ecosystems relates to the stability of ecosystems. **Key Idea 6: Plants and animals depend on each other and their physical environment.** PI 6.1 - Explain factors that limit growth of individuals and populations. PI 6.2 - Explain the importance of preserving diversity of species and habitats. PI 6.3 - Explain how the living and nonliving environments change over time and respond to disturbances. New York State Core Curriculum Standards Crosswalk - Living Environment	**HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. **HS-LS2-1:** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. **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.

✦Common Core Learning Standards

Reading	Writing

9-10.R.ST.2 **Reading: Key Ideas and Details** Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text. **9-10.R.ST.3** **Reading: Key Ideas and Details** Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks attending to special cases or exceptions defined in the text. **9-10.R.ST.9** **Reading: Integration of Knowledge and Ideas** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.	**9-10.W.HST.10** **Writing: Range of Writing** Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences. **9-10.W.HST.10** **Writing: Text Types and Purposes** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
Listening	**Speaking**

✦Unit Vocabulary

Consider using this list to guide the Explain or Elaborate portions of the 5E plans, and use it as reference for peer to peer vocabulary based discussions.

Unit Vocabulary	Domain Specific	Tier II

5E: COMPONENTS OF A STABLE ECOSYSTEM	Ecosystem Biotic factor Abitoic factor Food chain Food web Energy arrows Symbiosis (mutualism, commensalism, parasitism) Predator / prey Consumer / heterotroph Producer / autotroph Carnivore - herbivore - omnivore Primary / secondary / tertiary consumer Decomposer / saprovore / scavenger competition Trophic level Energy pyramid Nutrients / resources Nutrient cycling Carbon / nitrogen Energy loss Species - population - community - ecosystem Biomagnification bioaccumulation	Interact Stability Factors Components Relationships Impact Role
5E: POPULATION DYNAMICS	Predation / predator / prey Population dynamic Carrying capacity Dynamic equilibrium Interdependence Exponential growth Adaptation Co-evolution competition	Population Balance Resources Role limits
5E: ECOSYSTEM DISRUPTION & RECOVERY	Ecological succession Climax community Stability / stable ecosystem biodiversity	Disturbance Recovery resilience

5E: INVASIVE SPECIES	Invasive species Foreign species Native / non-native	Introduced Impact Recovery
OVERALL UNIT	Invasive Interconnected Interdependent Abiotic factors Biotic factors	Energy Matter Flow Cycle Impact introduce

*terms that may be encountered, but not fully defined or explored in this 5E Cycle