

**Unit 2: Ecology**  
**Environmental Science**  
16 Class Meetings

*Rev. June 2019*

**Essential Questions**

- What are the limitations on population size in ecosystems?

**Enduring Understandings with Unit Goals**

**EU 1:** A population's growth and size are limited by the carrying capacity of the environment.

- Explain the effect of limiting resources on carrying capacity.

**EU 2:** An organism's role in the environment is determined by both its tolerance and its competitive interactions.

- Compare and contrast species interactions among organisms in an ecosystem.
- Differentiate among producers, primary consumers, secondary consumers, and top predators.

**Standards**

**Next Generation Science Standards**

- **HS-ESS3-1.** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

**Common Core State Standards**

- **CCSS.ELA.CONTENT.WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research.
- **CCSS.ELA.CONTENT.RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account
- **CCSS.MATH.CONTENT.MP.2** Reason abstractly and quantitatively.
- **CCSS.MATH.CONTENT.MP.4** Model with mathematics.
- **CCSS.MATH.CONTENT.HSS.IC.B.6** Evaluate reports based on data.

**MSMHS Academic, Civic and Social Competencies**

**Competency 1.** Read and write effectively for a variety of purposes.

**Competency 2.** Speak effectively with a variety of audiences in an accountable manner.

**Competency 3.** Make decisions and solve problems independently and collaboratively.

**Competency 4.** Apply scientific knowledge and concepts to a variety of investigative tasks.

**Competency 5.** Contribute to a positive learning environment with respect and responsibility.

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### Unit Content Overview

- Unit Phenomena (such as Zebra Mussel population)
- Levels of ecological organization
- Population size, density, and distribution
- Population growth factors
- Exponential versus logistic growth
- Limiting factors
- Biotic potential
- Carrying capacity
- Speciation and extinction
- Species interactions
- Competition and limiting resources
- Bioaccumulation
- Biomagnification
- Predator/prey relationships
- Producers and consumers
- Energy flow (10% rule)
- Feeding relationships
- Invasive species

#### Interdisciplinary Connections

- Marine Studies 1: marine food webs, marine trophic levels
- Biology: energy Processes
- Algebra I: energy transfer ratios, lab calculations

### Learning Objectives with *TWPS Activities*

#### Students will be able to...

- Design a model that describes the “health” of the Great Lakes.
  - *How do organisms affect one another’s survival and environment?*
- Explain the different levels of ecological organization and define abiotic and biotic factors in an ecosystem.
  - *Explain why the common definition for species may be problematic for some organisms, such as bacteria.*
  - *For each level of organization, state whether it contains only biotic, only abiotic, or both biotic and abiotic factors.*
- Identify and describe the important characteristics of populations.

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- *An ecologist is carrying out a population study on songbirds in your area. Over a three-year period, the songbird population increases. Explain how the population was able to increase over that time period.*
- Evaluate the role of various factors in how a population's size changes.
  - *Why are there so many bacteria but so few whales? Why is there a difference between how many bacteria are in the world vs. how many whales are in the world?*
- Calculate population growth rates.
  - *The populations of bacteria are much higher than whales. Explain why there is much more bacteria than whales.*
- Describe the role of limiting factors and biotic potential on population growth.
  - *Analyze the amount of resources that the finches have on its island. Predict what will happen to the finches and its resources once the carrying capacity has been reached.*
- Describe how speciation and extinction affect the diversity of life on earth.
  - *Are all the species in the world the same species that were here a million years ago? Why or why not?*
- Explain the role of competition in the way an organism lives in its community.
  - *Stray cats have to compete with other species in order to survive. Explain the role of competition for stray cats to survive in its daily life.*
- Compare and contrast predation, parasitism, herbivory, mutualism, and commensalism.
  - *Create a short story that explains the symbiotic relationships between the following species: deer, wolf, tick, rabbit, and grass.*
- Create a mathematical model representing predator-prey relationships.
  - *Looking at the model, describe would happen to the predator population if the prey population were to decline in 20 years?*
- Explain the difference between a producer and a consumer.
  - *If a tertiary consumer's population declined unexpectedly, how will this impact the remaining food chain?*
- Evaluate the effects of bioaccumulation and biomagnification on species and environmental health.
  - *Analyze the diagram and explain how the eagles have a higher concentration of DDT than zooplankton.*
- Explain the effect of inefficient energy transfer on community structure.
  - *Explain why a vegetarian diet is considered to be more energy-efficient diet for humans than one based on beef, chicken or pork.*
- Describe how feeding relationships can have both direct and indirect effects on community members.
  - *Pollination is vital for plants. Evaluate whether pollination is important for human's survival.*
- Evaluate the roles of speciation and extinction in biodiversity.
  - *The climate has been rapidly increasing for many years. Describe what will happen to various species over time.*

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- Explain the conditions necessary for a species to become invasive.
  - *A person vacationing on a tropical island discovers a plant that only grows on that island. He decides to it home and plant it in his Connecticut garden. Explain how this plant can impact the garden.*
  - *The cane toad was brought to Australia from the island of Hawaii. The toad had been introduced to Hawaii some time earlier, but has not has the same kind of destructive effects there as it has in Australia. Explain why the toad has not become invasive in Hawaii as it did Australia.*
- Create a visual display educating peers on an invasive species.
  - *A federal agency has put you in charge of responding to the zebra mussel invasion. How would you try to control the mussel's spread and impact?*

### Instructional Strategies/Differentiated Instruction

- **HLP:** Academically Productive Talk
- **HLP:** Writing to Learn (TWPS)
- **HLP:** Effective Feedback
- Power Point Lecture with note-taking
- Guided note-taking
- Warm up activities
- Flexible grouping
- Independent reading
- Foldables
- Exit slips
- Graphic Organizers
- Creating authentic connections for students
- Vocabulary word bank
- Rephrasing and restatement of information and concepts
- Tiered instruction
- Alternative test settings
- Student use of headphones
- Reading and accountable talk discussions of texts
- Student-led instruction
- Homework assignments

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### Assessments

#### **FORMATIVE ASSESSMENTS:**

- “Oh Deer!” Lab
  - MSMHS Rubric 4: Scientific Research
- Invasive Species Wanted Poster Presentation
  - MSMHS Rubric 2: Accountable Talk
- Population Math Problems
- Daily Check-ins with students
- Accountable Talk Discussion
- Daily Think-Write-Pair Share (TWPS)
- Guided notes
- Homework
- Oral questioning
- Exit slips
- Warm Up activities
- Close reading and interpretation of text

#### **SUMMATIVE ASSESSMENTS:**

- Quiz on EU 1
- Quiz on EU 2
- “Oh Deer!” Lab
- Invasive Species Wanted Poster Presentations
- Unit Test

### Unit Task

**Unit Task Name:** Invasive Species Wanted Poster Presentations

**Description:** Students will use information learned in this unit population ecology and carrying capacity (EU 1), as well as concepts of species and community interactions (EU 2), to create a wanted poster for an invasive species of their choice. They must include information about the characteristics of that species, along with information about why it was able to become invasive in a particular area. After creating the poster, students will present information to the class in an accountable manner.

**Evaluation:** MSMHS Rubric 2: Accountable Talk

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### **Unit Resources**

- Textbook (Environment Science. Jay Withgott, Pearson Education, Inc. 2011.) Chapters 4 and 5
- MSMHS School-wide Rubrics
- Internet databases
- Graphing calculators
- POGIL: Population Ecology
- Science Takeout: Mercury Poisoning
- Large format poster printer
- Microsoft Power Point or Prezi
- Laptops