

# Ecology

Content Area: **Science**  
Course(s): **CP Environmental Science**  
Time Period: **Marking Period 2**  
Length: **3-4 weeks**  
Status: **Published**

## Course Pacing Guide

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Unit	MP/Trimester	Weeks
Biodiversity	1	4
Natural Resources	1	5
Ecology	2	6
Pollution	2	4
Energy	3	6
Agriculture	3	5
Human Health and the Environment	4	4
Climate Change	4	5

## Unit Overview

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To understand how to address environmental problems and, more specifically, to "fix" ecosystems, we must first understand how ecosystems work. In ecology students will examine the abiotic and biotic factors that interact in specific regions defining ecosystems. Students will examine how energy flow and nutrient cycles potentially keep ecosystems functioning. Regarding species interactions, students will identify examples and define how competition, symbiosis and food web interactions play out in ecosystems as part of individual species niches. At the population level students will learn the factors that influence a population and the main applications of population ecology. The parallels to human population dynamics will be examined. Aquatic ecosystems will be studied and compared to the ecology of terrestrial systems with emphasis on the factors that make the ecology of these systems different.

## Enduring Understandings

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Ecology is the study of ecosystems - the abiotic and biotic factors of a defined region.

To address environmental issues we must understand how ecosystems work.

Energy flow and nutrient cycles are two basic functions of every ecosystem.

Specific abiotic factors must be considered as it applies to range of tolerance and limiting factors.

Community interactions are diverse and essential in the functioning of ecosystems - these interactions are part of the niche of each species.

Disturbance is a natural process, but can also be anthropogenic, and communities respond to disturbance as they undergo succession.

Understanding population ecology is essential for a variety of human and conservation applications.

Human population change over time has been tied to natural processes as well as cultural and industrial processes.

Aquatic ecosystems have unique features which makes the study of aquatic ecosystems different with regards to the tools and applications.

## **Essential Questions**

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What are the key components in ecosystems?

How do abiotic factors affect biotic factors and vice versa

How do the laws of energy apply to the flow of energy ecosystems?

How do we measure productivity in ecosystems?

What are the main nutrient cycles and what are the key reservoirs and processes for each nutrient?

What are the key properties of an ecological community and how do they connect?

How do species interact with one another and how does that define their niche?

How do communities respond to disturbance in ecosystems and does this vary with natural vs. anthropogenic disturbance events?

What are the key properties of an ecological population and how do they apply to conservation and human activities?

What are the patterns of population growth in ecosystems and what factors affect this?

How does human population growth and change compare to natural populations?

What are the unique factors for aquatic systems?

How does studying aquatic ecosystems differ from terrestrial systems?

## New Jersey Student Learning Standards (No CCS)

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9-12.HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
9-12.HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
9-12.HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
9-12.HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
9-12.HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
9-12.HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
9-12.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
9-12.HS-LS2	Ecosystems: Interactions, Energy, and Dynamics
9-12.HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
9-12.HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
9-12.HS-LS1-4.2	Developing and Using Models
9-12.HS-LS1-2.2.1	Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-LS1-4.2.1	Use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-LS4-6.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-LS1-3.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
9-12.HS-LS2-3.5.1	Energy drives the cycling of matter within and between systems.

9-12.HS-LS4-6.5.1	Create or revise a simulation of a phenomenon, designed device, process, or system.
9-12.HS-LS2-1.5.1	Use mathematical and/or computational representations of phenomena or design solutions to support explanations.
9-12.HS-LS1-6.6	Constructing Explanations and Designing Solutions
9-12.HS-LS2-7.6.1	Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-LS1-3.7.1	Feedback (negative or positive) can stabilize or destabilize a system.
9-12.HS-LS2-6.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.
9-12.HS-LS1-1.LS1.A.1	Systems of specialized cells within organisms help them perform the essential functions of life.
9-12.HS-LS1-5.LS1.C	Organization for Matter and Energy Flow in Organisms
9-12.HS-LS1-6.LS1.C	Organization for Matter and Energy Flow in Organisms
9-12.HS-LS1-6.LS1.C.2	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.
9-12.HS-LS1-7.LS1.C.2	As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.
9-12.HS-LS2-1.LS2.A	Interdependent Relationships in Ecosystems
9-12.HS-LS2-2.LS2.A.1	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.
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9-12.HS-LS2-5.LS2.B	Cycles of Matter and Energy Transfer in Ecosystems
9-12.HS-LS2-4.LS2.B.1	Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
9-12.HS-LS2-3.LS2.B.1	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.

9-12.HS-LS2-6.LS2.C.1	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 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.
9-12.HS-LS2-7.LS2.C.1	Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.
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9-12.HS-LS4-6.LS4.C.1	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.
9-12.HS-LS2-7.LS4.D.1	Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
9-12.HS-LS4-6.LS4.D.1	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.
9-12.HS-LS2-7.LS4.D.2	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.
9-12.HS-LS2-5.PS3.D.1	The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
9-12.HS-LS4-6.ETS1.B.1	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

## Amistad Integration

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LA.RI.11-12.10b	By the end of grade 12, read and comprehend literary nonfiction at grade level text-complexity or above.
SEL.PK-12.1.2	Recognize the impact of one's feelings and thoughts on one's own behavior

## Holocaust/Genocide Education

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## Interdisciplinary Connections

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List at least one specific standard

No general statements

LA.RI.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain.
LA.RI.11-12.2	Determine two or more central ideas of a text, and analyze their development and how they interact to provide a complex analysis; provide an objective summary of the text.
LA.RI.11-12.3	Analyze a complex set of ideas or sequence of events and explain how specific individuals, ideas, or events interact and develop over the course of the text.
LA.RI.11-12.7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
LA.RL.11-12.2	Determine two or more themes or central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to produce a complex account; provide an objective summary of the text.
MA.S-IC.A.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
MA.S-IC.A.2	Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation.
MA.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
MA.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
MA.S-ID.A.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
MA.S-ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
PFL.9.1.12.A.8	Analyze different forms of currency and how currency is used to exchange goods and services.

## Technology Standards

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List specific standards that are relevant

No general statements

TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS1	Understand and use technology systems.

TECH.8.1.12.B.2	Apply previous content knowledge by creating and piloting a digital learning game or tutorial.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS3	Develop cultural understanding and global awareness by engaging with learners of other cultures.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.
TECH.8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.

## **21st Century Themes/Careers**

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List specific standards that are relevant  
No general statements

HPE.2.2.8.A.2	Demonstrate the use of refusal, negotiation, and assertiveness skills when responding to peer pressure, disagreements, or conflicts.
CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
CAEP.9.2.12.C.4	Analyze how economic conditions and societal changes influence employment trends and future education.
CAEP.9.2.12.C.5	Research career opportunities in the United States and abroad that require knowledge of world languages and diverse cultures.

## **Financial Literacy Integration**

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PFL.9.1.12.A.6	Summarize the financial risks and benefits of entrepreneurship as a career choice.
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## **Instructional Strategies & Learning Activities**

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Lab Reports

Field studies - Population Estimations

Field Studies - Community Ecology Studies

Biodiversity Inventories

Ecological Restoration Assessments

Citizen Science Project

Socratic Lecture and Class Discussion

Student led Inquiry and Presentation

## **Differentiated Instruction**

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- Curriculum Map
- Inquiry/Problem-Based Learning
- Learning preferences integration (visual, auditory, kinesthetic)
- Relationship-Building & Team-Building
- Self-Directed Learning
- Debate
- Student Data Inventories
- Mastery Learning (feedback toward goal)
- Goal-Setting & Learning Contracts
- Game-Based Learning
- Grouping
- Socratic Seminar
- Rubrics
- Learning Through Workstations
- Concept Attainment
- Mentoring
- Assessment Design & Backwards Planning
- Student Interest & Inventory Data

## **Formative Assessments**

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Leaf ID Quiz for trees in Cooper River Park

Students build a trophic pyramid from energy data in Cooper River Park

Shorebird Quiz for species present on shorebird surveys at North Brigantine Natural Area.

Students identify and describe community level interactions in Cooper River park

Students describe basic differences between lentic and lotic systems in Cooper River Park

Students produce an ecotone model from invertebrate data collected in Cooper River Park



## **Summative Assessment**

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Exam - General Ecology

Exam - Population Ecology

Exam - Community Ecology

Exam - Aquatic Ecology

Lab Report- Ecological Restoration in Cooper River Park - determining efficacy through ecological services

Lab Report- Estimating the Population of Corbicula clams in Cooper River

Lab Report - Shorebird abundance and richness at North Brigantine Natural Area

Lab Report - modeling ecotones using invertebrate richness in Cooper River Park

Lab Report - Community Species Area Curves - disturbance and community Richness at Croft Farm park

## **Benchmark Assessments**

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reference above

## **Alternate Assessments**

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reference above

## **Resources & Technology**

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Miller and Spoolman Text - Environmental Science

Field Guides - shorebirds of North America, Sibley guide to eastern birds, Boyd s Guide to the Pine Barrens

GPS technology

USGS Maps

Google Earth

## **BOE Approved Texts**

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Miller and Spoolman - Environmental Science - Sustaining your world

E.O. Wilson - Half Earth

## **Closure**

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Such as:

- Sequence It - create timelines of major events discussed
- Have students write down three quiz questions (to ask at the beginning of the next class).
- Question Stems - Have students write questions about the lesson on cards, using [question stems framed around Bloom's Taxonomy](#). Have students exchange cards and answer the question they have acquired.
- Have students dramatize a real-life application of a skill.
- Ask a question. Give students ten seconds to confer with peers before you call on a random student to answer. Repeat.
- Have kids orally describe a concept, procedure, or skill in terms so simple that a child in first grade would get it.
- Direct kids to raise their hands if they can answer your questions.
- Kids write notes to peers describing what they learned from them during class discussions.
- Have students complete the following sentence: "The [concept, skill, word] is like \_\_\_\_\_ because \_\_\_\_\_."
- Ask students to write what they learned
- After writing down the learning outcome, ask students to take a card, circle one of the following options, and return the card to you before they leave:

## **ELL**

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Such as:

- Alternate Responses
- Advance Notes
- Extended Time
- Teacher Modeling
- Simplified Written and Verbal Instructions
- Frequent Breaks

- E-Dictionaries
- Google Translate

## **Special Education**

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List is not inclusive but may include examples such as:

- Shorten assignments to focus on mastery of key concepts.
- Shorten spelling tests to focus on mastering the most functional words.
- Substitute alternatives for written assignments (clay models, posters, panoramas, collections, etc.)
- Specify and list exactly what the student will need to learn to pass.
- Evaluate the classroom structure against the student's needs (flexible structure, firm limits, etc.).
- Keep workspaces clear of unrelated materials.
- Keep the classroom quiet during intense learning times.
- Reduce visual distractions in the classroom (mobiles, etc.).
- Provide a computer for written work.
- Seat the student close to the teacher or a positive role model.
- Use a study carrel. (Provide extras so that the student is not singled out.)
- Provide an unobstructed view of the chalkboard, teacher, movie screen, etc.
- Keep extra supplies of classroom materials (pencils, books) on hand.
- Maintain adequate space between desks.
- Give directions in small steps and in as few words as possible.
- Number and sequence the steps in a task.
- Have student repeat the directions for a task.
- Provide visual aids.
- Go over directions orally.
- Provide a vocabulary list with definitions.
- Permit as much time as needed to finish tests.
- Allow tests to be taken in a room with few distractions (e.g., the library).
- Have test materials read to the student, and allow oral responses.
- Divide tests into small sections of similar questions or problems.
- Allow the student to complete an independent project as an alternative test.
- Give progress reports instead of grades.
- Grade spelling separately from content.
- Allow take-home or open-book tests.
- Show a model of the end product of directions (e.g., a completed math problem or finished quiz).
- Stand near the student when giving directions or presenting a lesson.
- Mark the correct answers rather than the incorrect ones.
- Permit a student to rework missed problems for a better grade.
- Average grades out when assignments are reworked, or grade on corrected work.
- Use a pass-fail or an alternative grading system when the student is assessed on his or her own growth.

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Examples of accommodations in 504 plans include but are not limited to:

- preferential seating
- extended time on tests and assignments
- reduced homework or classwork
- verbal, visual, or technology aids
- modified textbooks or audio-video materials
- behavior management support
- adjusted class schedules or grading
- verbal testing
- excused lateness, absence, or missed classwork
- pre-approved nurse's office visits and accompaniment to visits
- occupational or physical therapy

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### **At Risk**

Examples may include:

- Use of mnemonics
- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Use of a study carrel
- Assistance in maintaining uncluttered space
- Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
- Peer or scribe note-taking
- Lab and math sheets with highlighted instructions
- Graph paper to assist in organizing or lining up math problems
- Use of manipulatives
- No penalty for spelling errors or sloppy handwriting
- Follow a routine/schedule
- Teach time management skills
- Verbal and visual cues regarding directions and staying on task
- Adjusted assignment timelines
- Visual daily schedule
- Immediate feedback
- Work-in-progress check
- Pace long-term projects
- Preview test procedures
- Film or video supplements in place of reading text

- Pass/no pass option
- Cue/model expected behavior
- Use de-escalating strategies
- Use peer supports and mentoring
- Have parent sign homework/behavior chart
- Chart progress and maintain data

## **Gifted and Talented**

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Focus on effort and practice

Offer the Most Difficult First

Offer choice

Speak to Student Interests

Allow G/T students to work together

Encourage risk taking