NEW MILFORD PUBLIC SCHOOLS
New Milford, Connecticut

Ecology I

February 2012

Approved by the Board of Education
March 13, 2012

New Milford Board of Education

Wendy Faulenbach, Chairperson
Daniel Nichols, Vice Chairperson
Daniele Shook, Secretary
Lynette Celli Rigdon, Assistant Secretary
Tom Brant
David Lawson
Thomas McSherry
David R. Shaffer
William Wellman

Superintendent of Schools
JeanAnn C. Paddyfote, Ph.D.

Assistant Superintendent
Maureen E. McLaughlin, Ph.D.

New Milford High School Principal
Greg P. Shugrue

Authors of Course Guide
Eileen Reed
Ethan Saldana

New Milford’s Mission Statement

The mission of the New Milford Public Schools, a collaborative partnership of students, educators, family and community, is to prepare each and every student to compete and excel in an ever-changing world, embrace challenges with vigor, respect and appreciate the worth of every human being, and contribute to society by providing effective instruction and dynamic curriculum, offering a wide range of valuable experiences, and inspiring students to pursue their dreams and aspirations.

Ecology I

In Ecology I, emphasis is placed on ecosystems, their structure and their dynamics. Students study energy flow, feeding relationships, predator-prey, symbiosis, population dynamics, and other interactions within ecosystems, as well as the major biomes of the world. Students relate many of the concepts learned to Connecticut's own ecology. There is an emphasis on hands-on activities and project work. Students may contract for honors level credit with teacher recommendation.

Pacing Guide

Unit #	Title	Weeks	Pages
1	Introduction to Ecological Studies		7-10
	A. Statistical Analysis in Ecology	2	
	B. Ecosystem Structure and Dynamics	7	
2	Population Ecology	4	11-14
3	Biomes and Biodiversity	4	15-18
4	The Temperate Forest and Connecticut Ecosystems	3	19-21

Key for State Standards

RST = Common Core Reading Standards for Literacy in Science 6-12

WHST = Common Core Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12

CSF = Connecticut Science Framework for High School

INQ = CSF Inquiry Standard for High School

New Milford Public Schools

Committee Members: Eileen Reed, Ethan Saldana Unit 1: Introduction to Ecological Studies	Course/Subject: Ecology I Grade Levels: 11 / 12 # of Weeks: 9

Identify Desired Results

Common Core Standards

- **RST.3** Follow precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- **RST.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.
- **RST.5** Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- **WHST.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- **WHST.6** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback including new arguments or information.
- **CSF D INQ 1** Identify questions that can be answered through scientific investigation.
- **CSF D INQ 4** Design and conduct appropriate types of scientific investigations.
- **CSF D INQ 6** Use appropriate tools and techniques to gather data.
- **CSF D INQ 7** Assess the reliability of the data generated in an investigation.
- **CSF D INQ 8** Use mathematical operations to interpret data and present relationships in appropriate forms.
- **CSF Enrichment** Stability in an ecosystem is a balance between competing effects.
- **CSF Enrichment** Energy enters the Earth system primarily as solar radiation and eventually escapes as heat.
- **CSF Enrichment** Each element on Earth moves among reservoirs which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• To answer questions about the environment, scientists must be able to identify causes and describe solutions.	• How are statistical data and models applied to the study of ecology? • How can change in one part of an ecosystem affect change in other parts of the ecosystem? • How do matter and energy link organisms to each other and their environments?

• Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations. • Energy from the sun flows irreversibly through ecosystems and is conserved as organisms use and transform it. • Matter needed to sustain life is continually recycled. • Life on Earth depends on interactions among organisms and between organisms and their environment.	• Why is sunlight essential to life?

Expected Performances
What students should know and be able to do

Students will know the following:

- The difference between mean, median, and mode
- What a standard deviation is and when it is used
- The ecological organization of the biosphere
- The structure of an ecosystem
- How energy is transferred from the sun through the trophic levels of an ecosystem community
- How elements cycle through an ecosystem

Students will be able to do the following:

- Calculate mean, median, mode, range, and standard deviation
- Apply statistical data in ecology
- Map the components of the biosphere from most to least comprehensive
- Identify biotic and abiotic factors in representative ecosystems
- Use both a word and a chemical equation to show how energy is transferred from the sun to producers through photosynthesis
- Organize a representative community of producers, herbivores, carnivores, omnivores, and decomposers into a drawing of a food web and describe how a change in one component can affect the entire food web
- Depict the trophic levels of a community in an energy pyramid drawing, showing what happens to the energy from one level to the next
- Describe and draw the carbon, nitrogen, and phosphorus cycles

Character Attributes

- Cooperation
- Integrity
- Respect

Technology Competencies
• Collect data and organize on an Excel spreadsheet • Use online simulations • Use Vernier probeware to analyze pH, temperature, and other data

Develop Teaching and Learning Plan

Teaching Strategies:	Learning Activities:
• Teacher administers pre-assessment to identify students' current statistical skills and understanding of ecosystems. • Teacher gives guided notes using PowerPoint on ecosystem dynamics. • Teacher uses three-level guide for reading comprehension using relevant current event articles. • Teacher presents multiple intelligence activities with kinesthetic, interpersonal, logical, and musical intelligences applied to statistical calculations, ecological structure, and the changing ecosystem. • Teacher identifies similarities and differences between concepts, such as abiotic vs. biotic. • Teacher uses non-linguistic representations of ecosystem structure and change. • Teacher uses *Mind's Eye* to help students visualize a topic pertaining to ecosystem structure and change. • Teacher assigns homework to define key terms and to outline assigned text reading.	• Students will complete the lab: *Zebra Mussel.* • Students will create a complex food web and identify the different niches of organisms in an ecosystem: *Weaving a Tangle Web.* • Students will create a niche collage for a particular ecosystem. • Students will play a game that reinforces habitat concepts: *Habitat Go Fish.* • Students will create a variety of compost columns using different combinations of abiotic and biotic factors to identify factors that influence decomposition. • Students will observe the cycling of minerals and monitor changes in photosynthetic microbial populations over time: *Winogradsky Columns.* • Students will create a symphony that illustrates succession through sound: *Music Succession.* • Students will learn how Doppler radar is used to track insects and bats in Texas: *Maps in Action*. • Students will play a board game that demonstrates the complexities of the carbon cycle: *Carbon Cycle Game.* • Students will add personal learning goals to unit goals.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: Describe the basic structure and dynamics of ecosystems. **Role**: Writer and Illustrator **Audience**: Newspaper, educational magazine, journal **Situation**: You are a children's book author asked to create a book about the structure and dynamics of a particular ecosystem. **Product**: A children's book (paper or digital) **Standards for Success**: Rubric that outlines necessary educational and creative components	• Entrance/exit tickets with responses from students • Formative assessment through questioning • Properly made food webs • Standard assessment (test) • Lab analysis questions • Self-evaluation of knowledge gained (see true/false on teaching strategies)

Suggested Resources

- Arms, K., *Environmental Science*, Austin, TX: Holt, Rinehart and Winston, 2006.
- Bottle Biology
- The Microcosmos Project, Boston University.
- Connecticut Envirothon Curriculum www.ctenvirothon.org

New Milford Public Schools

Committee Members: Eileen Reed, Ethan Saldana Unit 2: Population Ecology	Course/Subject: Ecology I Grade Levels: 11 / 12 # of Weeks: 4

Identify Desired Results

Common Core Standards

- **RST.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.
- **RST.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.3** Follow precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- **RST.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.
- **RST.5** Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- **WHST.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- **WHST.6** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback including new arguments or information.
- **D INQ 1** Identify questions that can be answered through scientific investigation.
- **D INQ 4** Design and conduct appropriate types of scientific investigations.
- **D INQ 6** Use appropriate tools and techniques to gather data.
- **D INQ 7** Assess the reliability of the data generated in an investigation.
- **D INQ 8** Use mathematical operations to interpret data and present relationships in appropriate forms.
- **CSF Enrichment** Stability in an ecosystem is a balance between competing effects.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• Life on Earth depends on interactions among organisms and between organisms and their environment.	• How are the forces of population growth limited by environmental factors? • How do organisms affect each other's survival and environment?

Expected Performances
What students should know and be able to do

Students will know the following:

- The properties and dynamics of populations and population growth
- How different species exhibit different population growth properties depending upon their life histories
- The difference between density dependent and density independent limiting factors and how they affect population growth
- How population size is measured in the field

Students will be able to do the following:

- Describe the properties of population growth
- Explain reproductive potential for large (k-strategist) and small organisms (r-strategist)
- Describe a population
- Draw the different growth curves such as linear, S-curve, and J-curve
- Explain the relationships between limiting factors and carrying capacity
- Distinguish among and give examples of the different types of species interactions
- Estimate population sizes, both sedentary and mobile
- Explain how competition affects the populations involved
- Explain how predator/prey relationships balance populations
- Distinguish between density dependent and density independent population regulation
- Determine a population size in a representative ecosystem

Character Attributes

- Cooperation
- Respect

Technology Competencies

- Use of Excel to organize, analyze, and graph data collected from a variety of sources
- Research information from the Internet to support a view point
- Conduct online simulations on population ecology

Develop Teaching and Learning Plan	
Teaching Strategies: • Teacher pre-assesses students' understanding of population growth dynamics using knowledge rating scales and/or true / false questions. • Teacher gives guided notes using PowerPoint on population ecology. • Teacher identifies similarities and differences between population concepts such as density dependence and density independence, and clumped and uniform dispersion. • Teacher presents multiple intelligence activities with kinesthetic, interpersonal, logical, and musical intelligences applied to estimating populations, Competition lab, and Predator/Prey Interactions. • Teacher uses non-linguistic representations to describe the components of a population, such as density, dispersion, and carrying capacity. • Teacher uses three-level guide for reading comprehension using a current event article about populations, such as *"Where Should Wolves Roam?"* • Teacher demonstrates magnet summaries which identify a magnet word and the supporting information after reading segments of text about populations, such as *"In Long-Running Wolf-Moose Drama."* • Teacher assigns homework to define key terms and to outline assigned text reading.	Learning Activities: • Students will demonstrate the complexities of predator/prey interactions: *Lab: Predator/Prey Interactions*. • Students will demonstrate how competition affects the energy available for a population: *Lab: Competition (Bird Beak).* • Students will collect data on sessile organisms, including estimating population sizes, dispersion pattern, and densities: *Lab: Estimating populations (outside*). • Students will view video that demonstrates the complexities of organisms and how we are dependent upon each other: *Video- Brazil Nut Tree.* • Students will discuss and debate the current status of wolves and the reintroduction of wolves in Yellowstone: *Points of View- Where Should Wolves Roam* (*Reading for Information).* • Students will read about and analyze an attempt by humans to regulate a population with devastating results: *Activity: Kaibab Deer*. • Students will read *"In Long-Running Wolf-Moose Drama."* • Students will create an ad for a new relationship to demonstrate the interactions of two species. • Students will add personal learning goals to unit goals.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: Identify wildlife management practices, population monitoring techniques, and describe why populations need to be managed. **Role**: Scientist/Researcher **Audience**: DEP, state legislator **Situation**: Develop a Species Management Plan for a CT organism. **Product**: Students will prepare a report that plans the management of an invasive, pest, or endangered species in CT. **Standards for Success**: Plan rubric	• Exit tickets for formative assessments • Summaries of readings • Standard assessment (test) • Lab analysis questions

Suggested Resources

- Web Site on Population Curves: http://www.mathcs.org/java/programs/PopDynamics/index.html
- Peppered moth simulation http://www.biologycorner.com/worksheets/pepperedmoth.html
- Arms, K., *Environmental Science*, Austin, TX: Holt, Rinehart and Winston, 2006.
- Project Wet Curriculum and Activity Guide, Project WET International Foundation and CEE, 1995.
- Connecticut Envirothon Curriculum www.ctenvirothon.org

New Milford Public Schools

Committee Members: Eileen Reed, Ethan Saldana Unit 3: Biomes and Biodiversity	Course/Subject: Ecology I Grade Levels: 11 / 12 # of Weeks: 4

Identify Desired Results

Common Core Standards

- **RST.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.
- **RST.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.3** Follow precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- **RST.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context.
- **RST.5** Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- **WHST.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
- **WHST.6** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback including new arguments or information.
- **WHST.7** Conduct short as well as more sustained research projects to answer a question or to solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **D INQ 1**: Identify questions that can be answered through scientific investigation.
- **D INQ 4**: Design and conduct appropriate types of scientific investigations.
- **D INQ 6**: Use appropriate tools and techniques to gather data.
- **D INQ 7**: Assess the reliability of the data generated in an investigation.
- **D INQ 8**: Use mathematical operations to interpret data and present relationships in appropriate forms.
- **CSF Enrichment**: Stability in an ecosystem is a balance between competing effects.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• The ecosystems of the world are grouped into larger areas called biomes. • The major terrestrial biomes are defined by temperature and rainfall, which in turn determine the biome's biodiversity.	• How does the environment affect where and how an organism lives? • What are the major terrestrial and aquatic biomes of the world? • Why is it important to protect biodiversity?

Expected Performances
What students should know and be able to do

Students will know the following:

- The location and characteristics of the major biomes of the world
- The relationship between temperature, rainfall, latitude, and biodiversity

Students will be able to do the following:

- Identify and label the major terrestrial and aquatic biomes on a world map
- Read and create climatographs
- Identify the major characteristics of the world's terrestrial and aquatic biomes
- Describe biodiversity of different biomes (or hotspots)

Character Attributes

- Compassion
- Cooperation
- Respect
- Responsibility

Technology Competencies

- Use a word processing program to develop a brochure
- Conduct research on the Internet
- Use Audacity to create audio clips
- Use Photostory to create a collage or a picture story of endangered species in CT

Develop Teaching and Learning Plan	
Teaching Strategies: • Teacher pre-assesses students' understanding of biodiversity and biomes using knowledge rating scale, true/false, and other style questions. • Teacher gives guided notes using PowerPoint on biomes and biodiversity. • Teacher makes current event connections through research and readings pertaining to biodiversity and biomes, using topics such as the Arctic National Wildlife Refuge. • Teacher presents multiple intelligence activities with kinesthetic, interpersonal, and logical components about biomes and biodiversity. • Teacher identifies similarities and differences between biomes and biodiversity concepts such as temperate vs. tropical or climate vs. weather. • Teacher uses *Mind's Eye* to help students visualize topics about biodiversity and biomes, such as factors that affect climate. • Teacher assigns homework to define key terms and to outline assigned text reading.	Learning Activities: • Students will create climatograms of different biomes to identify key temperature and precipitation patterns, which are like fingerprints for biomes. • Students will create an ecotourism vacation brochure for a specific biome. • Students will *research* different biomes and their resources, such as fruits from rain forests. • Students will compare rainfall totals for different biomes using string. • Students will discuss the Arctic National Wildlife Refuge (Writing for Information). • Students will create questions and answers about a biome and present as a news report. • Students will add personal learning goals to unit goals.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: Understand ecotourism and relate it to the different biomes. **Role**: Interviewer and expert **Audience**: NPR listeners **Situation**: NPR is proposing a new educational segment to their program about ecotourism for different biomes. **Product**: Create a 5-10 minute podcast about a specific biome, describing the climate, uniqueness, importance for its conservation, and potential experiences. **Standards for Success**: Skills and knowledge rubric and checklist	• Climatogram questions • Exit tickets as formative assessments • Summaries of readings • Standard assessment (test) • Formative assessments through questioning

Suggested Resources

- Arms, K., *Environmental Science*, Austin, TX: Holt, Rinehart and Winston, 2006.

New Milford Public Schools

Committee Members: Eileen Reed, Ethan Saldana Unit 4: The Temperate Forest and Connecticut Ecosystems	Course/Subject: Ecology I Grade Level: 11 / 12 # of Weeks: 3

Identify Desired Results

Common Core Standards

- **RST.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.
- **RST.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.3** Follow precisely a complex multi-step procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
- **RST.4** Determine the meaning of symbols, key terms, and other domain-specific word and phrases as they are used in a specific scientific or technical context.
- **RST.5** Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- **WHST.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments or technical processes.
- **WHST.6** Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback including new arguments or information.
- **WHST.7** Conduct short, as well as more sustained research projects, to answer a question or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Enduring Understandings Generalizations of desired understanding via essential questions (Students will understand that …)	**Essential Questions** Inquiry used to explore generalizations
• The environment is dynamic and will change when stresses are placed upon it. • As educated citizens, people are responsible for maintaining the CT forests. • People can have an altering, sometimes devastating, effect on ecosystems.	• What are ecosystem services and why are they important to us? • Why is it important to protect Connecticut forests? • How have humans altered the landscape of Connecticut?

Expected Performances
What students should know and be able to do

Students will know the following:

- The ecosystem services provided by Connecticut forests
- How human activity has shaped Connecticut forests and wildlife composition over the past 300 years

Students will be able to do the following:

- Identify the common shrubs, deciduous, and coniferous trees of Connecticut
- Identify the common mammals, reptiles, and amphibians of Connecticut
- Describe the ecosystem services provided by Connecticut forests
- Identify endangered species in Connecticut
- Describe the history of the Connecticut forests
- Explain how the change in forests influences the animals in the Connecticut forests

Character Attributes

- Citizenship
- Cooperation
- Respect
- Responsibility

Technology Competencies

- Use Internet research for information or to support a view point
- Create a PowerPoint presentation

Develop Teaching and Learning Plan

Teaching Strategies:	Learning Activities:
• Teacher pre-assesses students' knowledge of Connecticut's forests using knowledge rating scale, true/false, and other style questions. • Teacher gives guided notes using PowerPoint on the history of Connecticut's forest current forest management strategies. • Teacher makes current event connections through research and readings. • Teacher presents multiple Intelligence activities with interpersonal, logical, linguistic, and natural intelligences related to temperate ecosystems and Connecticut forest such as a time line of Connecticut forests, and a	• Students will make a time line of historical events in Connecticut that caused ecological change. • Students will create a photostory about endangered plants and animals of Connecticut. • Students will write a letter to a State representative explaining the importance of maintaining forested areas in the state of Connecticut. • Students will use PowerPoint to create a report to oppose the conversion of a forested area into a residential development. • Students will research, discuss, and/or debate a current issue pertaining to Connecticut forests. • Students will research the variety of organisms in an ecosystem and then

• Teacher identifies similarities and differences between the different ecosystems of Connecticut. • Teacher uses non-linguistic representations for the different stages of forest use in Connecticut's history. • Teacher presents story impressions about the history of Connecticut forests. • Teacher uses the 5 W reading model using anecdotal readings about the history of Connecticut's forests. • Teacher uses Corners to create discussion about Connecticut forest issues.	create a food web. • Students will create and use a dichotomous key booklet for the main trees found in Connecticut. • Students will add personal learning goals to unit goals.

Assessments

Performance Task Authentic application to evaluate student achievement of desired results designed according to GRASPS (one per marking period)	**Other Evidence** Application that is functional in a classroom context to evaluate student achievement of desired results
Goal: Understand why forested areas should be preserved. **Role**: Nature advocate and citizen **Audience**: General Public/Town Meeting **Situation**: Town is proposing to build a residential development where a 900 acre virgin forest currently stands. **Performance**: Prepare a presentation that opposes the destruction of the area. **Standards for Success**: Rubric outlining the different skills and knowledge for this unit	• Successfully identify Connecticut trees from leaves, bark, and/or seeds • Place historical events in Connecticut into proper chronological sequence • Self-evaluation of knoweldge learned • Formative assessments through questioning • Exit tickets as formative assessments • Standard assessment (test)

Suggested Resources

- Arms, K., *Environmental Science*, Austin, TX: Holt, Rinehart and Winston, 2006.
- Connecticut Envirothon Curriculum www.**ctenvirothon**.org