Performance Task:

Wildlife and Lyme Disease: Connections and Control

Grade Level: 10–12

Referencing Vermont Proficiency-Based Graduation Requirements for Clear and Effective Communication, Life Sciences, and Engineering, Technology, and Application of Science

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Overview

Across Vermont, rates of infection by Lyme disease have been increasing dramatically over the past ten years. When people think about this, they often think of what humans can do differently to deal with it, for example, wearing long sleeves or using tick repellant.

However, the spirochete that causes Lyme disease is part of an ecosystem, and changes to the ecosystem can affect it.

In this project, students will explore some of the plant and animal species that are connected to Lyme disease. After analyzing data and learning about the complex interactions between these species, they will produce a written position paper for the Commissioner of Fish and Wildlife with recommendations for appropriate wildlife management steps that the Department of Fish and Wildlife could take to help reduce Lyme disease infection in Vermont. This project will enable students to demonstrate their proficiency as Clear and Effective Communicators as well as their ability to apply the principles of ecology to a problem that is facing their state.

Standards and Learning Targets

TRANSFERABLE SKILLS

Graduation Proficiency: Clear and Effective Communication

a. Demonstrate organized and purposeful communication.
b. Use evidence and logic appropriately in communication.
c. Integrate information gathered from active speaking and listening.
d. Adjust communication based on the audience, context, and purpose.
f. Use technology to further enhance and disseminate communication.

Drawn from AOE Sample Proficiency-Based Graduation Requirements for Science (PBGRs):

SCIENCE

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

8. Engineering, Technology, and Application of Science

b. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Possible Interdisciplinary Connections

This project could be done as an interdisciplinary project with Social Studies, where it would be connected to these standards:

Drawn from AOE Sample Global Citizenship PBGRs

Inquiry

a. Ask focused, probing, and significant questions that encourage inquiry around an issue of

personal, community, or global relevance.

d. Propose solutions to problems based on findings, and ask additional questions.

Civics, Government and Society

a. Explain and defend their own point of view on issues that affect themselves and society; use information gained from reputable sources; explain, critically evaluate, and defend views that are not one's own.

Drawn from AOE Sample English Language Arts and Literacy PBGRs

1. Reading

b. Determine the central ideas of the text and provide an objective summary.

d. Determine the meaning of words and phrases as they are used in the text.

2. Writing

a. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

d. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

e. Use technology to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Big Ideas/Enduring Understanding

Ecosystems are composed of numerous species that are connected to one another in complex webs. Changes to the conditions, abundance or management of one species can affect many of the others.

Focus Questions

- How are various plant and animal species in Vermont ecosystems connected to Lyme disease?
- How can changes in the ecosystem affect *Borrelia burgdorferi*, the bacteria that cause Lyme disease?
- How can we use ecological principles – in the form of wildlife management, forestry, town planning, landscaping, or other strategies - to reduce the spread of Lyme or to reduce infection of humans by Lyme?

Culminating Task

Students will produce a work of writing, audio, graphic design or video that is designed to communicate to the Commissioner of Fish and Wildlife, the Commissioner of Agriculture, the Commissioner of Health, or the head of any other relevant Vermont State Agency a recommendation for appropriate management of one or more of the species that is connected to Lyme disease. Students may choose their mode of communication and may design their text or audio/visual/video piece according to their own creative vision. However, they must ensure that their final product is effective at communicating their ideas and appropriate for the audience of a state government official.

The students will include evidence from class debate, discussions, informational texts, videos and other sources to strengthen their recommendations about appropriate management of these species. The recommendation must include:

- A clear claim;
- Sufficient evidence supporting the claim;
- Thorough reasoning that explains the position; and
- Acknowledgment and rebuttal of counter arguments(s) that might arise.

The students can choose to write about any species or ecological relationship that they find interesting. Each student should use digital technology to enhance their argument in some way, through the inclusion of graphics, charts, video, audio, or effective design and layout.

In order to assess students' proficiency of the biology standards covered, each teacher should use the scoring criteria or proficiency scales that have been developed by their school for each of the performance indicators that students will demonstrate.

Content/Sources/Materials

Links to Supporting Materials
(Students will need access to computers to complete this task)

Lyme Disease and Deer Tick General Information
Lyme Disease – write-up from Tufts University
Ticks and Lyme Prevention
Black-legged Ticks – Minnesota Department of Health
Collection of Lyme Disease Resources

Supplemental Resources About how Lyme interacts with other organisms
Barberry, Bambi and Bugs: The Link Between Japanese Barberry and Lyme Disease
The Barberry War: To Plant or Destroy? That is the Question
More Ticks, More Misery
Why You Should Brake for Oppossums
The Acorn Connections
Lyme disease surge predicted for Northeastern US: Due to acorns and mice, not mild winter
Predators, Prey and Lyme Disease

Activity on Lyme Disease Ecology

Additional Sources for Student Research
Habitat Fragmentation [and effects on Lyme Disease]
The Lyme Disease Debate: Host Biodiversity and Human Disease Risk (advanced source)

Formative Tasks, Directions and Instructional Supports

All formative tasks, directions, instructional supports and supporting materials are included in the pages following the description and Student Instructions for the culminating task.

Science Task Description

Standards & Learning Targets

Graduation Proficiency: Clear and Effective Communication

a. Demonstrate organized and purposeful communication.
b. Use evidence and logic appropriately in communication.
c. Integrate information gathered from active speaking and listening.
d. Adjust communication based on the audience, context, and purpose.
e. Demonstrate effective, expressive, and receptive communication, including oral, written, multi-media, and performance.
f. Use technology to further enhance and disseminate communication.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

8. Engineering, Technology, and Application of Science

b. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Texts/Other Materials Needed

- Students will need access to computers on which they can compose their position piece.

Teacher Instructions

1. Hand out the project rubric and review your expectations with the students.
2. Have the students use the Position Paper Design Guide to plan and write their paper.

Possible Project Extensions

In this project, students will be proposing strategies and potential regulations to the Commissioner of the Vermont Fish and Wildlife Department. For possible ways to bring additional authenticity to the project, you could contact a local branch or office of the Fish and Wildlife Department and see if a representative might be able to speak to your students about real initiatives concerning Lyme disease in your area. Another possibility might be to invite local or state officials to review the student work or watch student presentations.

Student Science Task Instructions

You have studied data and discussed the issues with your classmates. Now is your chance to answer our guiding question: **How can we use ecological principles to control the spread of Lyme disease in Vermont?**

Your task will be to produce a work of writing, audio, graphic design, or video that is designed to communicate to the Commissioner of Fish and Wildlife, the Commissioner of Agriculture, the Commissioner of Health, or the head of any other relevant Vermont State Agency a recommendation for appropriate management of one or more of the species that is connected to Lyme disease. You may choose your mode of communication and you may design your text or audio/visual piece according to your own creative vision. However, you must ensure that the final product is effective at communicating your ideas and appropriate for the audience of a state government official.

Your position piece must include:

- A clear claim.
- Sufficient evidence supporting the claim. Be sure to include evidence from class debate, discussions, informational texts, videos and other sources to strengthen your recommendations about appropriate management of these species.
- Thorough reasoning that explains your position.
- Acknowledgment and rebuttal of counter arguments(s) that might arise.

You can choose to write about any species or ecological relationship that you find interesting.
Use digital technology to enhance your argument in some way, through the inclusion of graphics, charts, video, audio, or effective design and layout.

Plan your position piece by filling in each of the sections below. Then use these notes to help you build a complete argument. All of the categories listed here must be addressed. Once you have outlined your claims and evidence here, you can organize and present your argument.

1. What variable related to the spread of Lyme disease will you address?

2. What evidence indicates that this variable is critical?

3. What current regulations, guidelines, or supports exist that address this variable?

4. Describe your idea for regulation, guidelines, or a Fish and Wildlife program to address the variable that you have highlighted. Use evidence from your research to indicate why you think your proposal will be effective.

5. What have you learned from discussion with your peers or from your peer's presentations that has influenced your thinking about this?

6. What unintended consequences of your plan need to be considered? Why do you think these consequences might arise from your solution? Why is your plan worth the risk?

7. Once the regulation or program been in place for a year, what data could you collect that would help you determine whether it had been a success or not?

Grading Rubric for Position Paper – Ecology Standards

(Clear & Effective Communication will be graded using the TS1 Scoring Criteria)

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Each teacher should use the scoring criteria or proficiency scales that have been developed by their school or district for Biology Performance Indicator 4F, shown above.

Students should also be assessed using the Scoring Criteria for Performance Indicators A, B, C, D, and F for Clear and Effective Communication.

Formative/Supporting Activities

The activities on the following pages can be used to help students gather data and craft their arguments. Teachers can select from this list of activities (or add to it) depending on their needs and the needs of their students. **This task is intended to follow or be included within a unit on ecosystems, and so it is assumed that the teacher will be using their own materials to teach the ecological concepts that students must know in order to demonstrate proficiency on the Science performance indicators. These materials are intended to support science teachers in teaching the transferable skills that are being assessed with this task.** Please feel free to amend or change any of these to fit the needs of your classroom, and to modify them as needed to fit your students' needs.

NOTE: *In order for the students to fulfill the requirements of the task model, they will need to be able to participate in at least one evidence-based discussion before creating their final product.*

Possible Project Extensions

1. If this task is done as an interdisciplinary project with Global Citizenship, it could be expanded to include an exploration of the history of other diseases and how they have changed the course of history.
2. Students who have addressed similar or common topics could collaborate together to develop a consensus position paper for the Fish and Wildlife Commissioner incorporating all of the most compelling points made by each student. These group letters can then be mailed to the Commissioner in order to give the students a chance to have their voices heard.

Instructional Activity: Anchoring Phenomenon Activity - Lyme Disease Connections

Standards & Learning Targets

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- Lyme On the Rise: A Look at The Numbers
- Lyme Disease Maps: 2005 and 2014
- Deer Harvest Over the Years in VT
- CDC Lyme Maps

Goal

The goal of this activity is to activate students' prior knowledge about Lyme Disease and to get them thinking about the essential questions in the project.

Instructional Plan

Anchoring Phenomenon Activity

Begin by projecting the series of maps that are shown in the document called "Lyme Disease on the Rise."

You may want to start off by inviting students to journal or share the stories of their own connections to Lyme disease. Do they know anyone whose life has been affected by Lyme? Do they know of celebrities affected by Lyme? Has the threat of Lyme disease affected their outdoor activities?

Once the students have reflected and/or shared about their own connections to Lyme, have them examine the series of maps. Have them journal in response to the following questions:

- What do you see here? Identify the patterns that you see in this series of maps.
- What more would you like to know about this?

After the students have discussed their responses, share with them the focus question of the project that they are about to start: **How can we use ecological principles to control the spread of Lyme disease in Vermont?** (You could preface this by asking students to help you list on the board the way that people try to prevent Lyme disease transmission).

Then have the students work in small groups to brainstorm as many answers as they can to the following questions:

- What variables might contribute to the spread of Lyme disease? (Brainstorm as many as you can.)
- What variables might cause some counties to have more Lyme infections than others? (Brainstorm as many as you can.)

These additional resources can be made available to students while they brainstorm:
Lyme Disease Maps: 2005 and 2014
Deer Harvest Over the Years in VT
CDC Lyme Maps

Instructional Activity: Lyme Disease Facts

Standards & Learning Targets
Graduation Proficiency: Clear and Effective Communication

c. Integrate information gathered from active speaking and listening.

Texts/Other Materials Needed

- Avril Lavigne On Her Struggle With Lyme Disease

Goal

The goal of this activity is to provide students with background information about Lyme Disease.

Instructional Plan

1. **Hook:** Share short video clip: Avril Lavigne On Her Struggle With Lyme Disease
    - Have students use a K/W/E/L chart to take notes about Lyme from this video clip.
        - In the "**K**nowledge" section, students should list facts about the disease that they already know.
        - In the "**W**ant to Know" section, they should list questions that they have about the disease.
        - "**E**vidence" to support what they have "**L**earned" would also be included in the appropriate columns.

2. Share CDC brochure with students.
    - (An additional resource can be the CDC slide show on Lyme disease).
    - After reviewing the brochure and/or slide show, students should add new information to their K/W/E/L chart.

3. Teacher led Debrief.
    - Possible questions...
        - What new knowledge did you come away with?
        - What surprised you?
        - What are some lingering questions that you have about Lyme disease?
        - What aspect of the disease is most compelling or interesting to you?
        - What have you learned about how bacteria interact with an ecosystem?

4. Have students choose an aspect of the disease they are interested in to create an infographic.
    - Possible resources to support further research:
        - CDC Slide Show referenced above
        - Lyme Disease – write-up from Tufts University
        - Collection of Lyme Disease Resources

5. Students share infographic with class. This may be achieved through individual presentations or through a gallery walk during which students can leave comments for one another on sticky notes.

K/W/E/L Chart

K - What I think I know	W - What I want to know	E-What the evidence shows	L - What I've learned

Instructional Activity: Lyme Disease Ecosystem Connections

Standards & Learning Targets
Graduation Proficiency: Clear and Effective Communication

a. Use evidence and logic appropriately in communication.
c. Integrate information gathered from active speaking and listening.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- Barberry, Bambi and Bugs: The Link Between Japanese Barberry and Lyme Disease
  By Jones, Beth. Published by Scientific American, March 30, 2011.

Goal

The goal of this activity is to provide students with some data about the ecology of Lyme disease.

Instructional Plan

1. **Provide background information to give students a context in which to understand the text. Context:** This text was published by the magazine Scientific American to serve as an explanation for laypeople about the connections between the landscaping plant barberry (Berberis thunbergii) and black-legged ticks. It is available for free online.

2. **Read some portions of the text out loud as students follow along.** Asking students to listen to the text while they follow along exposes them to the vocabulary, structure, and content of the text before they begin their independent reading of the text. Reading out loud with students following along improves fluency, while offering all students access to complex text.

3. **Students reread the text independently.** This silent reading is critical to cultivating independence and creating a culture of close reading with students.

4. **Guide discussion of the text with a series of specific text-dependent questions and tasks.**

5. **Give students a choice of constructed response writing prompts to assess their understanding of the text.** Providing additional application or inquiry questions for students can guide critical thinking about the content.

Essential Vocabulary

Invasive – This ecological term refers to any species that is not native to an area and which has the capacity to spread through an ecosystem, displacing native species and causing other adverse affects.
Shade-tolerant – this term is used to describe plants that need relatively little sunshine and can grow in the shade.
Prevalence – commonness
Spirochete – spiral-shaped bacteria
Nymphal tick – a tick in its second active stage of development
Desiccate – dry out

Text-Based Questions

1. What are the qualities of Barberry that make it such an invasive species? List at least six.
2. Why does the area under a barberry plant stay more humid than under other plants? Why does this matter in terms of Lyme disease?
3. Draw a connections map, cartoon, or diagram to explain the connections between barberry, deer, white-footed mice and other rodents, and ticks.

Writing Prompts

1. List three follow-up questions that you could investigate in order to learn more about the topics discussed in this text.
2. How do the connections between barberry, deer, mice and Lyme disease create opportunities for controlling the spread of the disease?

Instructional Activity: Lyme Disease Ecosystem Connections Map

Standards & Learning Targets

Graduation Proficiency: Clear and Effective Communication

a. Use evidence and logic appropriately in communication.
b. Integrate information gathered from active speaking and listening.
g. Collaborate effectively and respectfully.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- More Ticks, More Misery
- Why You Should Brake for Oppossums
- The Acorn Connections
- Lyme disease surge predicted for Northeastern US: Due to acorns and mice, not mild winter
- Predators, Prey and Lyme Disease
- Habitat Fragmentation [and effects on Lyme Disease]
- The Lyme Disease Debate: Host Biodiversity and Human Disease Risk (advanced source)

Goal

Students will work together to map out some of the factors in the Vermont ecosystem that can affect black-legged ticks and the bacteria *Borrelia burgdorferi.*

Instructional Plan

Divide students into 6 or 7 groups (use 7 groups if you would like to assign the most advanced article, "The Lyme Disease Debate," to a group.) Assign an article to each group along with the instructions to read the article and respond to it using the guiding questions on the next page. They will need either a classroom block or some homework time to complete this.

After the students have completed their preparation, have them work together as a class, either on a blank wall (using pieces of paper) or on a whiteboard, to create a Connections Map that will illustrate the complex connections between *Borrelia burgdorferi* and many other species. (Creating the Connections Map on a blank wall using pieces of paper will be preferable, as it will be easier to leave it up to guide discussions during the rest of the project.) On the next page, you will find a sample Connections Map. You may want to use this to have your students sketch out or prepare to fill out the large Connections Map on the wall.

Prepare students by handing out the small Connections Map. Explain that Connections Maps are used to visually depict the various interconnections between species and resources in an ecosystem. Point out that the arrows have specific meanings; arrows that point in one direction indicate a relationship in which one variable or species affects another, but is unaffected itself by the relationship. For example, between sunshine and plants there is a one-way arrow; the sunshine affects the plants, but the plants

do not affect the sun. Two-way arrows are used to indicate when two species or variables affect each other; for example, a two-way arrow between foxes and mice would indicate that foxes predate mice, and that population crashes among the mice can cause starvation among the foxes. In some cases, two curved arrows that form a circle might be used to indicate a positive feedback loop between two species or variables; for example, an increase in logging might cause an increase in road building, and then the increase in roads might cause even more logging.

After handing out the instructions page, give students some time in their groups to plan what they will put on the wall. You may want to have groups check in and get your approval first. Once they are ready, they can print or draw their contributions to the connections map and attach them to the wall.

Here is an additional resource for helping students think about Lyme disease ecology: The Ecology of Lyme Disease.

Student Worksheet: Guiding Questions for Connections Map Articles

1. What connections between various plant and animal species and Lyme disease are described in this article?

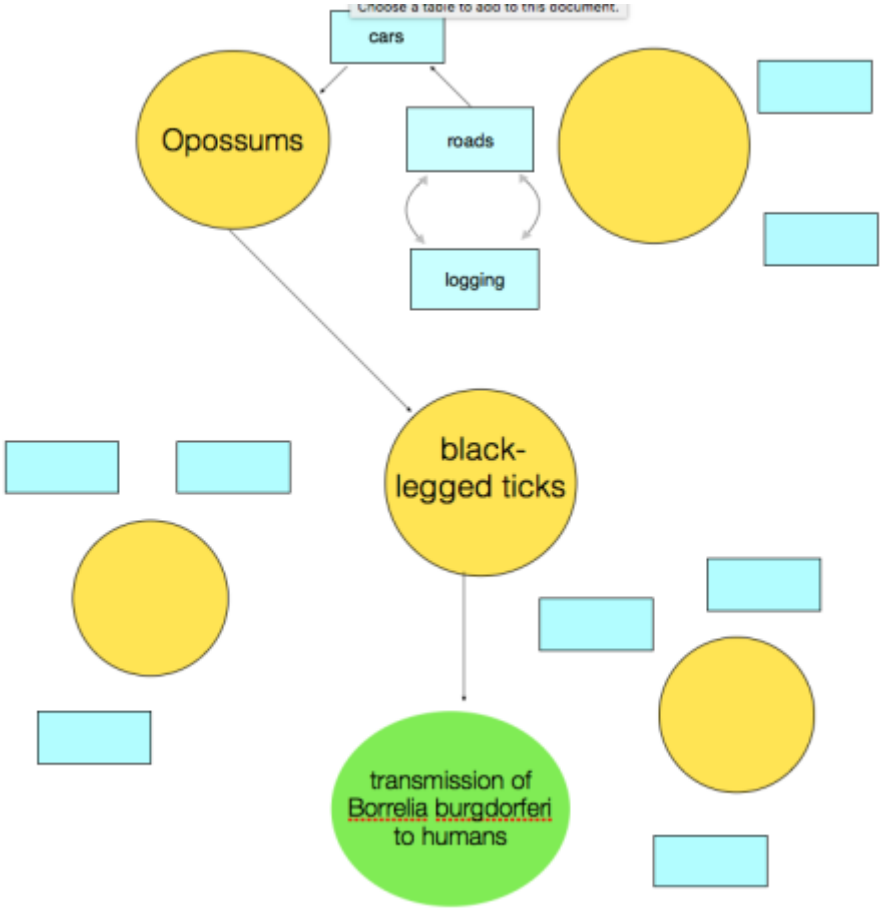
2. In your opinion, how could changes in the management of any of these species affect *Borrelia burgdorferi*, the spirochete that causes Lyme disease, or black-legged ticks, the species that transmits it to humans?

3. Based on these connections, what laws, regulations, or guidelines related to wildlife management, forestry, agriculture, landscaping, or zoning might work to reduce the spread of Lyme or to reduce infection of humans by Lyme?

4. Explain a connection that exists between this article and one other source that you have read so far during this project.

Sample Connections Map

This connections map is intended to serve as a sample of what yours could look like. One connection has been filled out for you as an example. Your map may list more factors contributing to the size of the tick population, or fewer, and each factor may have many other contributing factors influencing it. Be thoughtful about how you place your arrows; If two factors influence each other, use circular arrows to indicate this (in the sample, you can see this relationship depicted between "logging" and "road-building," because logging causes roads to be built, and then the roads enable more forest to be logged). If one factor influences many others, then many arrows may radiate from that factor. You can design your connections map on a computer or draw it by hand. If you use this sheet, add boxes, circles and arrows as needed.



Instructional Activity: Managing White-Tailed Deer in Suburban Environments

Standards & Learning Targets

Graduation Proficiency: Clear and Effective Communication

c. Use evidence and logic appropriately in communication.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- Managing White-Tailed Deer In Suburban Environments
  By Anthony J. DeNicola, Kurt C. VerCauteren, Paul D. Curtis, and Scott E. Hygnstrom. Published by the Cornell Cooperative Extension, the Wildlife Society– Wildlife Damage Management Working Group, and the Northeast Wildlife Damage Research and Outreach Cooperative. (pages 6–8)

Goal

The goal of this activity is to provide students with basic data about the biology of the white-tailed deer, a species with strong links to Lyme disease.

Instructional Plan

1. **Provide background information to give students a context in which to understand the text. Context:** This text was published by the Cornell Cooperative Extension, the Wildlife Society and the Northeast Wildlife Damage Research and Outreach Cooperative to serve as a resource for landowners and town managers. It is available for free online.

2. **Read some portions of the text out loud as students follow along.** Asking students to listen to the text while they follow along exposes them to the vocabulary, structure, and content of the text before they begin their independent reading of the text. Reading out loud with students following along improves fluency, while offering all students access to complex text.

3. **Students reread the text independently.** This silent reading is critical to cultivating independence and creating a culture of close reading with students.

4. **Guide discussion of the text with a series of specific text-dependent questions and tasks.**

5. **Give students a choice of constructed response writing prompts to assess their understanding of the text.** Providing additional application or inquiry questions for students can guide critical thinking about the content.

Additional Resource: An additional resource for helping students understand white-tail deer behavior, life cycle, and population changes in the USA is the video ***Oh Deer! White-Tailed Deer Biology****. (8 min)*

Essential Vocabulary
Complement – completes or brings to perfection
Subspecies – a taxonomic category that ranks below species, usually a fairly permanent geographically isolated race.
Estrous (sometimes spelled estrus) – a recurring period of sexual receptivity and fertility in many female mammals; heat.
Edge species – a species that thrives in the edges between forests and open land.
Pelage – fur
Forage – leafy food sources
Refugia – hiding places
Mortality – death
Species richness – the number of different species in an area

Text-Based Questions (pages 6–8)

1. Why do suburban areas or corporate lawns provide such excellent habitat for deer?
2. Explain which environmental conditions can cause the deer population to grow quickly.
3. Explain the concept of Biological Carrying Capacity.
4. What is "yarding?"
5. Identify two features about white-tailed deer that might be important in managing their population and explain your reasoning.
6. What are two reasons why male deer have a higher mortality rate than female deer, even in areas where hunting is not allowed?
7. How does this text connect with our focus questions:
    - How are various plant and animal species in Vermont ecosystems connected to Lyme disease?
    - How can changes in the management of these species affect *Borrelia burgdorferi*, the spirochete that causes Lyme disease?
    - How can we use wildlife management to reduce the spread of Lyme or to reduce infection of humans by Lyme?

Writing Prompts

1. List three follow-up questions that you could investigate in order to learn more about the topics discussed in this section of the text.
2. How could logging in Vermont forests affect deer herds?

Instructional Activity: Managing White-Tailed Deer in Suburban Environments

Standards & Learning Targets

Graduation Proficiency: Clear and Effective Communication

a. Use evidence and logic appropriately in communication.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- Managing White-Tailed Deer In Suburban Environments
  By Anthony J. DeNicola, Kurt C. VerCauteren, Paul D. Curtis, and Scott E. Hygnstrom. Published by the Cornell Cooperative Extension, the Wildlife Society– Wildlife Damage Management Working Group, and the Northeast Wildlife Damage Research and Outreach Cooperative (pages 1–5)
- Potential Additional Resource: The "Oh Deer" activity that is included in the Project Wild K-12 Curriculum and Activity Guide can also be a good resource for helping students learn about deer ecology.

Goal

The goal of this activity is to provide students with data about the potential hazards and conflicts that can exist for humans when the deer population rises.

Instructional Plan

1. **Provide background information to give students a context in which to understand the text. Context:** This text was published by the Cornell Cooperative Extension, the Wildlife Society and the Northeast Wildlife Damage Research and Outreach Cooperative to serve as a resource for landowners and town managers. It is available for free online.

2. **Read some portions of the text out loud as students follow along.** Asking students to listen to the text while they follow along exposes them to the vocabulary, structure, and content of the text before they begin their independent reading of the text. Reading out loud with students following along improves fluency, while offering all students access to complex text.

3. **Students reread the text independently.** This silent reading is critical to cultivating independence and creating a culture of close reading with students.

4. **Guide discussion of the text with a series of specific text-dependent questions and tasks.**
5. **Give students a choice of constructed response writing prompts to assess their understanding of the text.** Providing additional application or inquiry questions for students can guide critical thinking about the content.

Essential Vocabulary

Prevalent – common
Overabundance – excessive in quantity
Overbrowsing – when herbivores consume more leaves and shoots than plants can tolerate
Vector – an agent that causes or helps the transmission of a disease
Climax Species – the species that exist in a stable community of plants that has evolved over time to be self-sustaining and established in a certain place

Text-Based Questions (pages 1–5)

1. The authors list numerous conflicts or hazards that can exist for humans when the deer population rises. List at least five of these conflicts or hazards.
2. What is the relationship between white-tailed deer and diseases in a suburban environment? Provide examples to support your response.
3. How can deer change the plant and animal species composition of a forest?

Writing Prompts

1. Which of the potential conflicts or hazards that can exist for humans when the deer population rises seem most important to you? What steps do you think the Fish and Wildlife department should take in response to this potential hazard?

Instructional Activity: A Plague of Deer

Standards & Learning Targets

Graduation Proficiency: Clear and Effective Communication

a. Use evidence and logic appropriately in communication.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- Levy, Sharon (2006). A Plague of Deer: BioScience: Vol 56, No. 9.

Goal

The goal of this activity is to provide students with an additional perspective on the relationships between predators, herbivores, and plants.

Instructional Plan

1. **Provide background information to give students a context in which to understand the text. Context:** This article was published in the academic journal BioScience in 2006. This article is a feature article and not a peer-reviewed report of research results.

2. **Read some portions of the text out loud as students follow along.** Asking students to listen to the text while they follow along exposes them to the vocabulary, structure, and content of the text before they begin their independent reading of the text. Reading out loud with students following along improves fluency, while offering all students access to complex text.

3. **Students reread the text independently.** This silent reading is critical to cultivating independence and creating a culture of close reading with students.

4. **Guide discussion of the text with a series of specific text-dependent questions and tasks.**

5. **Give students a choice of constructed response writing prompts to assess their understanding of the text.** Providing additional application or inquiry questions for students can guide critical thinking about the content.

Essential Vocabulary

Diverse – containing many different species
Monotony – sameness; containing only a small number of species
Shade Tolerant – plants that can grow in the shade of taller trees
Suppresses – keeps from growing
Understory – the plants and shrubs that grow in a forest beneath the taller trees
Recalcitrant Understory Layers – plants that form a dense layer in the understory and stop other seedlings from sprouting because they cast such dark shade.

Demographic – related to the structure of a population
Anemic – weak and sickly
Desuetude – the state of not being used or not being usable
Stymied – stopped

Text-Based Questions (Pages 718–719)

1. Why does Levy say the hay scented fern and black cherry are now dominating eastern forests? What advantage do these species have over other plant species?
2. According to this article, why do deer love clear cuts?
3. When hay-scented fern grows in a thick carpet on the forest floor, how does it affect the forest?
4. Draw an illustration, comic, or other graphic to illustrate the relationship between deer, hay-scented fern, and other native understory plants and tree seedlings.
5. Find a quote on page 719 that you find important or surprising. Explain what this quote means and why you chose it.

Text-Based Questions (Pages 720–721)

1. What are three ways that the growing deer population on Anticosti Island has changed the island's ecosystem?
2. The quote from Aldo Leopold on page 720 contains these lines: "…I thought that because fewer wolves meant more deer, no wolves would mean a hunter's paradise. After seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view." Explain what Aldo Leopold means when he says that the mountain would not agree with him.
3. Explain the changes in plant diversity that have happened in Yellowstone National Park since wolves were reintroduced there.

Writing Prompts

1. If the author of this article, Sharon Levy, were told that she had to summarize her most important points in three sentences, what would she write?
2. What important lessons could the Vermont Fish and Wildlife Department take from this article? Support your claims with evidence from the text.

Supplementary Activity on Connections among Predators, Herbivores and Plants within an ecosystem:

An article entitled "Trophic Cascades in Yellowstone: The First 15 Years After Wolf Reintroduction," published in the journal *Biological Conservation* in 2011, is a very high-level source, however the graphs that appear on page 3 could be used in an activity to have students draw conclusions about how the rising and falling populations depicted in the graphs may be linked to one another.

Instructional Activity: Class Discussion: How can Vermont Most Effectively Reduce the Incidence of Infection by Lyme Disease?

Standards & Learning Targets

Graduation Proficiency: Clear and Effective Communication

a. Integrate information gathered from active speaking and listening.
b. Use evidence and logic appropriately in communication.
d. Adjust communication based on the audience, context, and purpose.
e. Demonstrate effective, expressive, and receptive communication, including oral, written, multi-media, and performance.
g. Collaborate effectively and respectfully.

4. Life Sciences: Matter and Energy in Organisms and Ecosystems

f. 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. (HS-LS2-6)

Texts/Other Materials Needed

- All readings and students' work in response to prior instructional activities
- Computers may be needed if the teacher would like to require additional research

Teacher Instructions

The **Discussion Preparation Organizer** (see pages 31-32) should be given to students at least one class period prior to the discussion.

On the day of the discussion, arrange the desks in a circle so that students can all see each other. Review the **Guidelines for Discussion**, the **rubric for discussion**, and the **Advice and Reminders** (on the following pages). Have students take out the work they did in response to the preparation sheet and give them a few minutes to review their responses.

NOTE: Before the discussion, you may want to do a class activity in which students create another Connections Map with factors influencing the deer population. However, this time, instead of working individually, the students can work together to make a large map on the classroom wall or whiteboard.

Remind students that in their final products for this project, they will need to integrate information that they learned from the discussions. In order to be ready to do this, they will need to take notes. They can use the optional notes organizer provided.

In order to start off the discussion, repeat the central question (you may want to have this on the board as well). "**How can Vermont Most Effectively Reduce the Incidence of Infection by Lyme Disease?"** Let one student start the discussion; after this person, students will raise their hands to talk, and the most recent person to speak will call on the next one. You may want to transcribe the discussion as it unfolds; this will give you a record of the discussion for grading, and will also help you stay in the

background as the students lead the conversation. Step in to redirect or deepen the discussion with new questions as needed. **Be sure to instruct students to use the note-taking organizer as they listen so that they can refer to information they learned from this discussion in their final project.**

Discussion Preparation Organizer

At our next class, we will discuss this question: *"How can Vermont Most Effectively Reduce the Incidence of Infection by Lyme Disease?"* This sheet will help you prepare to contribute to this discussion.

1. Review your notes and answers to questions on the readings that we have done so far about Lyme disease. These may include:
    - Lyme Disease Maps: 2005 and 2014
    - Deer Harvest Over the Years in VT
    - CDC Lyme Maps
    - CDC brochure
    - Barberry, Bambi and Bugs: The Link Between Japanese Barberry and Lyme Disease
    - More Ticks, More Misery
    - Why You Should Brake for Oppossums
    - The Acorn Connections
    - Lyme disease surge predicted for Northeastern US: Due to acorns and mice, not mild winter
    - Predators, Prey and Lyme Disease
    - Habitat Fragmentation [and effects on Lyme Disease]
    - The Lyme Disease Debate: Host Biodiversity and Human Disease Risk
    - A Plague of Deer
    - Managing White-Tailed Deer In Suburban Environments

2. Choose any four readings that you found interesting or important. For each source, create a summary which identifies the central claim of the author and at least three pieces of evidence that he or she uses to support that claim. If the article you choose does not make a claim, but rather compiles information, describe the sections in which that information is categorized and summarized the central points that are made in each section. At the end of each summary, answer this question: **What would the author of this text see as the top priority for a Lyme disease management plan?**

A. Title of Article:
Author's Name:
Author's View:

B. Title of Article:
Author's Name:
Author's View:

C. Title of Article:
Author's Name:

Author's View:

D. Title of Article:
Author's Name:
Author's View:

After reading the articles and writing your summaries, step back and consider your own viewpoint. The Vermont governmental agencies must consider many variables as they work to craft the best possible plans, policies, regulations and guidelines for the management and control of Lyme disease. But some considerations must be given more weight than others. **In your opinion,** what is the issue or concern that the Commissioners should focus on the **most closely** when crafting Vermont policy?

3. In the space below, describe the action that you think the State of Vermont could take that would have the most power to control the spread of Lyme disease.

4. Review the texts you have read and list below the evidence they provide which can support your argument. List at least three pieces of evidence.

Guidelines for Discussion

Instructional Activity

1. Every member of the class should contribute to the discussion at least once. No member of the class should dominate the discussion.
2. Back up your points with evidence. Either refer to a quote from one of the texts we are discussing, or cite an outside text, relevant personal observation, or other source which can support your argument.
3. You will be graded based on the quality of your contributions to the discussion. This grade will be determined by the following factors

Grading Factors

1. Did you make at least one substantive contribution to the discussion?
2. Were you respectful and attentive? Did you make space for other class members to talk?
3. To what extent did you refer to the readings or to other sources in order to support your arguments? Did you do additional research beyond the assigned readings?
4. Did you respond to the arguments made by other students and build upon others' understandings of the text, asking for clarification or definition of terms?
5. Did you avoid bringing in personal stories or comments of little relevance or value to the class discussion?

Some Advice & Reminders

- If you are shy or not inclined to jump in, try to start the discussion with an observation or claim.
- One person will be chosen to start the discussion in response to our focus question. If you want to get into the discussion, raise your hand, and the person who has just spoken will choose the next speaker. When it is your turn to pass the discussion to someone else, try to choose someone who has not spoken yet.
- We will make space at the end of every discussion for anyone who has not spoken to add something.
- Silence is ok – don't let it make you uncomfortable. If the class hits a silent point, don't feel you need to jump in just to fill the silence. Other people may be trying to think out a point or find a certain quote before jumping in.
- Hold yourself to a high standard before you talk: ask yourself, does this add to the class discussion? Is it relevant? (e.g., NOT a story about your wonder dog or your Aunt Martha.)
- Don't make it personal. Remember, even if you disagreed with a statement, that does not mean the person who said it is utterly wrong, lacking in perception, or out of their mind. Avoid statements like "I think you're *wrong*," in favor of "I see the text differently," or "I disagree with that interpretation because…".
- Use confident body language to help yourself feel strong, powerful and ready to contribute. Don't curl up and try to hide – sit back, stretch out, and take up space.

Scoring Guide for Discussions

G. Collaborate effectively and respectfully.

	Beginning	Developing	Proficient	Expanding
G. Collaborate effectively and respectfully.	I can • Identify the features of effective collaboration.	I can • Contribute my own ideas to group interaction.	I can • Respond respectfully and thoughtfully to diverse perspectives to promote an exchange of ideas with reasoning and evidence.	I can • Facilitate small and large group interactions or help others facilitate; Or • Create alternative evidence that expands upon proficient.

Note-taking Organizer

Speaker	Notes

Instructional Activity: Clear and Effective Communication in the Sciences

Standards & Learning Targets
Graduation Proficiency: Clear and Effective Communication

a. Demonstrate organized and purposeful communication.
b. Use evidence and logic appropriately in communication.
c. Integrate information gathered from active speaking and listening.
d. Adjust communication based on the audience, context, and purpose.
e. Demonstrate effective, expressive, and receptive communication, including oral, written, multi-media, and performance.
f. Use technology to further enhance and disseminate communication.

Texts/Other Materials Needed

- All readings and students' work in response to prior instructional activities
- A copy of the scoring criteria for Clear and Effective Communication

Teacher Instructions

This reflective activity is designed to help students think about the strategies used by the authors they have read to communicate clearly and effectively about scientific subjects. It should be utilized towards the end of the project, when students have explored many sources and are ready to create their own persuasive texts to argue for the approach that they think would be most effective.

First take some time to review the Scoring Criteria for Clear and Effective Communication with the students.

Then break students into groups. Give them approximately 10 – 15 minutes to review the texts that they have read or videos or other information sources they have utilized in their research, and to answer the questions on the next page. Then have small groups discuss their choices. The goal of each group will be to work together to create a list of the qualities that they observed in the most effective pieces they chose. Reserve time for each group to share their observations. These qualities can be listed on chart paper, a Google Doc or the whiteboard so that students can refer to it as they create their own pieces.

On the last page you will find a set of similar questions that can be used to guide peer conferences on the drafts of the students' products.

Student Worksheet: Clear and Effective Communication in the Sciences

1. Review the texts and other sources that you have read or utilized while learning about Lyme disease. Which text (or video, podcast, etc...) did the best job of explaining scientific ideas in a clear and effective way?

2. In the space below, list three things that the author of this piece does (including the use of graphics, illustrations, video or audio) to make their piece clear and effective. Include quotes or examples.

3. Choose any three Performance Indicators from the Scoring Criteria for Clear and Effective Communication. What score would you give this author in each of these three areas? Why?

Student Worksheet: Clear and Effective Communication in the Sciences – Peer Conference Guide

Review your partner's draft and answer and discuss the following questions with them.

1. What do you think is the central claim that your partner is trying to support in his or her piece?

2. What evidence, examples or data has your partner used to support this claim?

3. What is unclear or confusing in this piece?

4. What would you like to hear more about?

5. Choose any three Performance Indicators from the Scoring Criteria for Clear and Effective Communication. What score would you give this author in each of these three areas? Why?