One way to help students develop critical thinking skills is to focus on problems or cases where they are challenged to deal with real data and experiences (Bransford et al. 2004). Both problem-based learning and case studies allow students to develop the intellectual capacity to deal with complex issues, build confidence and willingness to approach topics from multiple perspectives, and encourage communication with scientists and peers from other disciplines. Students often compartmentalize content and process knowledge by discipline, whereas an interdisciplinary approach allows them to draw from multiple resources in the life sciences, mathematics, social sciences, and other disciplines. The literature is rich with examples and methods for using case studies (see References) and the majority of authors agree that if a case study is to be useful pedagogically, it must serve a specific function for the course and students. Such focus provides students with a more efficient means of achieving specific learning goals as compared to the traditional lecture approach (Herreid 1994, 1998).

Kremen and Ostfeld's paper on ecosystem services (pp 540–48) contains two case studies that provide examples of how ecological data are not often collected or interpreted in isolation. We use the Lyme disease case study to demonstrate how real data can be used to teach complex topics, while enabling students to discover how a number of disciplines can inform ecological issues. This activity is designed for an ecology course but could also be used as part of an introductory biology course.

### Student goals

- Identify the issues and interdisciplinary components of a case study.
- Analyze data to develop a management strategy about a case study.
- Find information from scientific sources that increases knowledge about the case.
- Interrelate the ecological concepts of ecosystem services, biodiversity, functional diversity, community disassembly, and landscape ecology.
- Work productively and collaboratively in a team.

### Instructor goals

- Design instruction using an interdisciplinary case study.
- Expose students to complex ecological concepts.

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**Lyme disease: a case about ecosystem services**

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**Instructional design**

### Problem posing: analyzing a case

Begin with a mini-lecture that includes background information on Lyme disease: for example, a brief description of the disease, how it is spread by ticks, a general description of tick life cycles, and a primer on the many possible hosts that ticks feed on, including a brief explanation about differential rates of transmission of the Lyme disease spirochete between different hosts and ticks (resources in References). In groups of two to four, students are asked, “How would you manage the problem of Lyme disease to reduce the prevalence of infected ticks?” Students are given four pieces of data to develop their management plan (Panel 1) and to support it with evidence.

A subset of groups reports out (one minute per group) their proposed management strategy to the class. The instructor lists the different strategies on poster-size post-its; those groups who do not report identify which of the strategies most closely approximates their own. One individual from each group (ie the recorder) adds a check mark (or small post-it) to the appropriate poster. This formative assessment enables the instructor to determine students’ initial level of understanding about the case and allows groups to evaluate their ideas in relation to their peers.

Next, students read the Lyme disease case study in Kremen and Ostfeld, and are told that they may include other information in the paper to revise the details of their management plan. As a tool to guide their thinking, each group generates a “Know/Need to Know” table (http://serc.carleton.edu/introgeo/icbl/strategy4.html), finds the additional information they “need to know” from scientific resources, cites the resources under the appropriate “need”, and submits both the table and citations with their revised management plan. In addition, if the instructor has access to a classroom management system such as Blackboard, Angel, or WebCT, each group could post one unique (not already posted) citation on the course website as part of the homework.

### Assessing student learning

Each group’s revised management strategy should reflect students’ comprehension of the case study and ability to use information to support recommendations to address the problem. The rubric in Panel 2 shows the criteria of an exemplary response that is provided to students before they begin the case study. “Adequate” and “Needs
Improvement” categories are scaled down in terms of content, accuracy, and possible points from the “Exemplary” level response. Additional questions on exams should provide further insight into student thinking. For example:

- Why are intact, unfragmented ecosystems associated with a lower prevalence of Lyme disease?
- Use the first case study in Kremen and Ostfeld (“Pollination services for crops in Northern California”, p 544) to answer the question of how and why the proportion of natural (wild) habitat surrounding a farm affects pollination services.

Final note

The literature on case studies is extensive, and this article represents only the tip of the iceberg in their use by students as a means to practice the analysis of information to comprehend and address interdisciplinary problems. The instructor could include many other goals and resources, thereby expanding the case over a series of classes. For example, this Lyme disease case study interconnects the ecological literature on biodiversity and ecosystem services with conservation issues, private property rights, economic concerns for developers or others likely to be negatively impacted by certain management options, and the environmental ethics that arise when human and environmental interests are at odds. Assessment data are collected at multiple points during the case study, to provide both students and the instructor with ongoing feedback about learning.

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References


Online case study resources


Additional sources about Lyme disease