

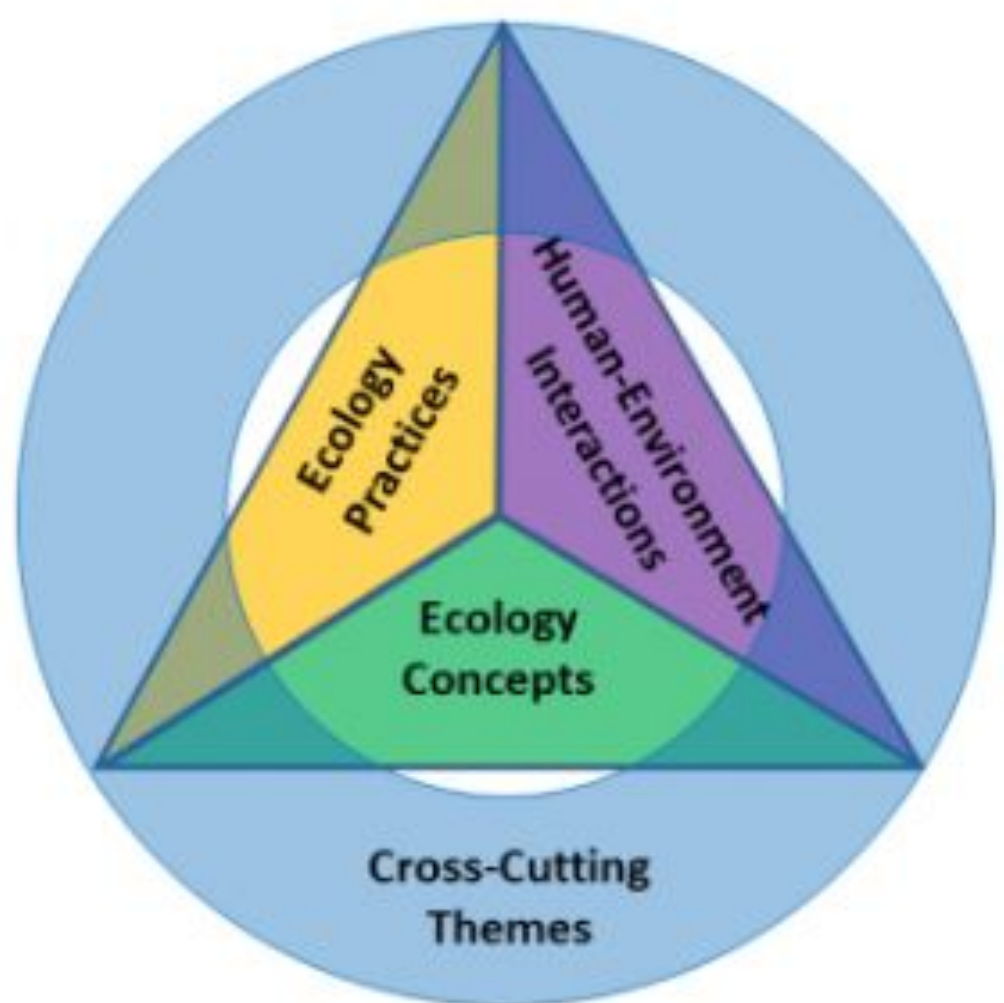
Transforming ecology major courses to meet the goals of the ESA-endorsed 4DEE curricular framework



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<https://www.esa.org/4dee>



4DEE Course Transformation Pathway

START – 1) Assess your *current* course’s lesson coverage of each of the four dimensions

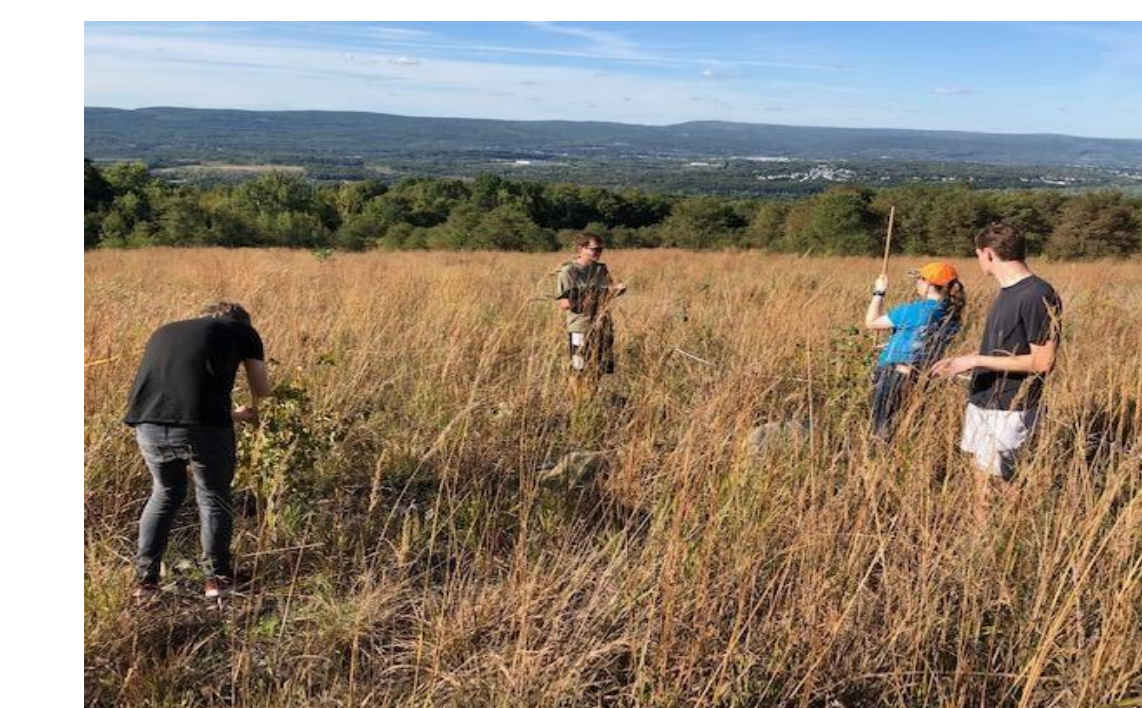
Core Ecological Concepts (CEC)	Ecology Practices (EP)	Human-Environment Interactions (HEI)	Cross-Cutting Themes (CCT)
<ul style="list-style-type: none"> Organisms Population Community Ecosystems Landscapes Biomes Biosphere 	<ul style="list-style-type: none"> Natural history Fieldwork Quantitative reasoning & computational thinking Designing & critiquing investigations Working collaboratively Communicating 	<ul style="list-style-type: none"> Human dependence on the environment Human accelerated environmental change How humans shape & manage resources, ecosystems, the environment Ethical dimensions 	<ul style="list-style-type: none"> Structure & function Pathways & transformations of matter & energy Systems Spatial & temporal scale

2) Note any existing 2-dimensional (e.g. CEC x EP), 3-dimensional (e.g. CEC x EP x HEI) or 4-dimensional *integration* (e.g. CEC x EP x HEI x CCT) topics in each of your syllabus learning activities

3) For each learning activity you plan, decide which core topic you will focus on engaging students in *multiple-dimensional thinking*

Recommendations for 4DEE ecology majors faculty

- Increase human dimension integration into every topic discussed in lecture and lab – engage students in doing the historical and current online research to appreciate that dimension
- Divide the class into work groups that address different dimensions and engage them in connecting the dimensions



Ecology students sampling plants in a reclaimed coal mine in Pennsylvania; an example of integration of integration of studying an ecological concept, engaging in ecological practices while addressing human environment interactions

- Intentionally let students know of the importance of integrating the 4DEE dimensions in understanding of any basic ecological principles
- Make students aware of environmental career skills they are learning (ecological practices) in any lab experience, whether through fieldwork or online resources
- Connect to major biological cross-cutting themes – comparing across habitats or geographic locations, focusing on structure, function, scale, system change

ESA Four-Dimensional Ecology Education Framework

In 2018, ESA endorsed a Four-dimensional Ecology Education curricular framework (4DEE), recognizing that to educate students to meet today’s ecological workforce needs requires **planned** ecology course **integration** of:

1. teaching the hierarchy of core ecological concepts (CEC)
2. engaging in updated ecological field data collection and analysis, interpretation, communication practices (EP)
3. addressing the human-environmental interactions (HEI)
4. connecting ecological concepts to cross-cutting biological themes - structure/function, scales, system change (CCT)

Example 1: 4DEE wetland delineation activity

Core ecological concepts (CEC)

Individuals, populations, communities, ecosystems, landscapes all pertain to wetlands



Ecology practices (EP)

Natural history, fieldwork, quantitative reasoning, and collaboration can apply to wetlands. Students learn marketable skills by interpreting maps and identifying wetlands

Human-environment interactions (HEI)

Wetlands benefit society; humans have disturbed wetlands

Cross-cutting themes (CCT)

Wetlands are systems that have scale, structure, function, transform matter and energy and can be disturbed

Integration of dimensions covered in lab or associated lecture involve 2-dimensional, 3-dimensional and 4-dimensional interactions:

Ecological practices involved in wetland delineation provide students with direct opportunity to investigate human impact and dependence on wetlands while exploring cross-cutting themes of scale, disturbance, structure and function and system change

TRANSFORM YOUR LESSON(S) TO FIT 4-DEE IN FIVE EASY STEPS

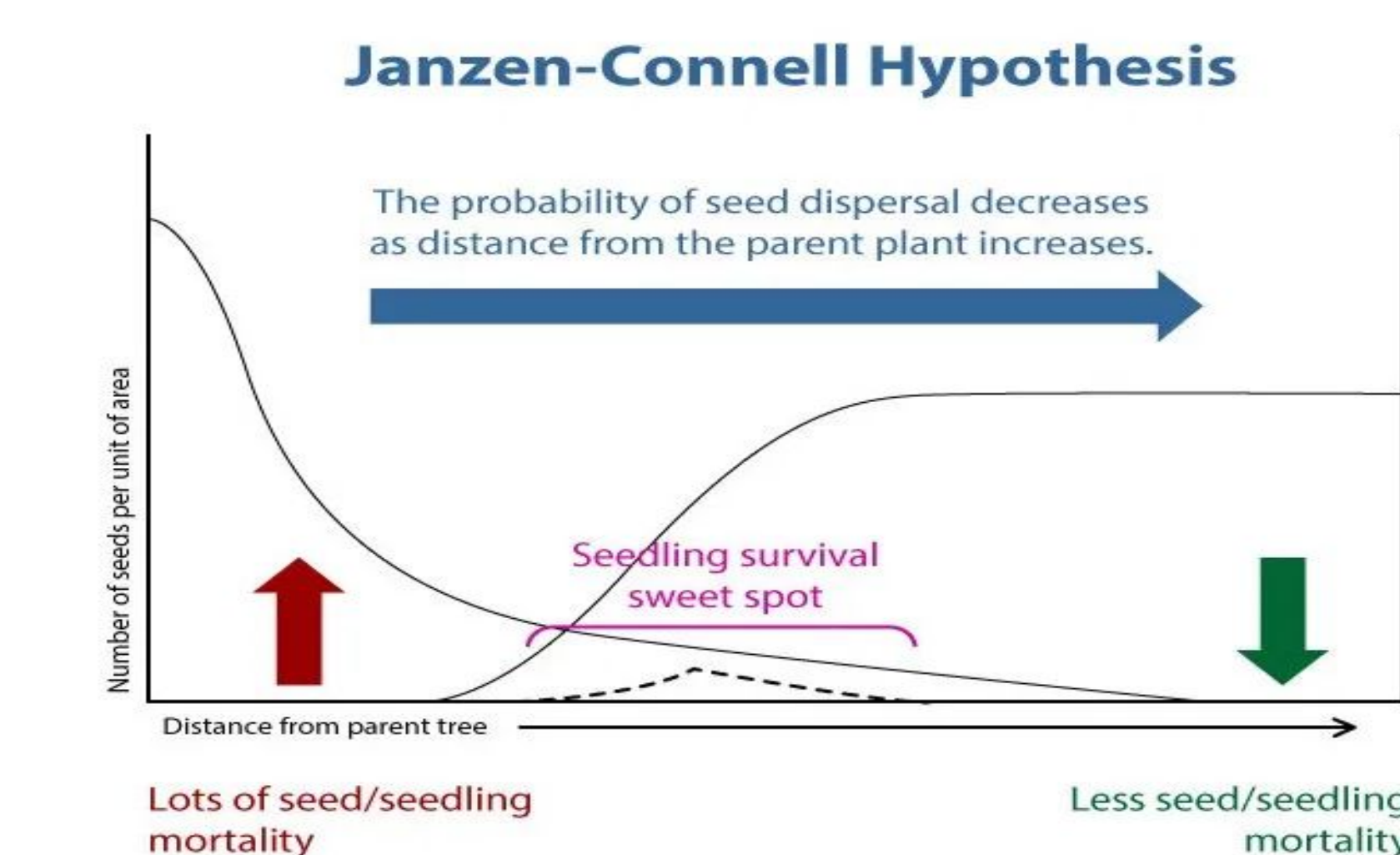
- 1) List core ecological concept to cover in lesson plan
- 2) Indicate ecological practices featured
- 3) Outline human dimensions to discuss in lecture and lab on topic
- 4) Make students aware of biological cross-cutting themes connected to lesson’s core ecological concept
- 5) List your class and exam questions, online research assignment, lab report, oral or poster presentation approach which were used to assess students’ abilities to understand the dimensions’ interactions you integrated in the learning activity



Check out ESA 4DEE website education resources:

<https://www.esa.org/4DEE>

Example 2 - 4DEE environmental distribution pattern activity



Janzen-Connell hypothesis i.e. both seedling density and seed predation decrease with distance from mother tree

Core ecological concepts and learning objectives - Gathering data on seedling dispersal and seedling recruitment to **plot** curves for seedling success in establishment as a function of distance from the maternal plant.

Ecology practices - data analysis and interpretation, figure construction and presentation

Human dimension - connection of tropical tree distribution patterns to timber harvesting practices in tropical forests, and impact on greenhouse gas emissions, weather.

Cross-cutting themes - comparing impact of different timber harvesting practices on the system’s energy transformation capabilities of tropical forests

****Although coverage of these elements along each dimension is expected to increase with educational level, e.g. grad > undergrad > K12, even at the highest levels, coverage *per se* is not the goal. *Rather, the goal is to integrate between and across dimensions.***