ESA 4DEE Framework

- Teaching the hierarchy of core ecological concepts (CEC)
- Engaging in updated ecological field data collection and analysis, interpretation, communication practices (EP)
- Addressing the human-environmental interactions (HEI)
- Connecting ecological concepts to cross-cutting biological themes - structure/function, scales, system change (CCT)

Recommendations

- 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
- 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 (ecology 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

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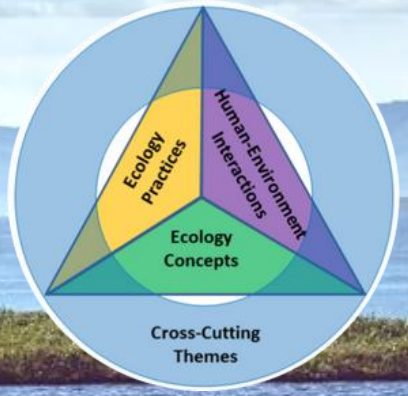
Transforming Ecology Courses to 4D

Four Dimensional Ecology Education Framework



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For more info on the framework please visit the 4DEE website or scan the QR code

https://esa.org/4dee/

Transform Your Lesson In Five Easy Steps

- List core ecological concept to cover in lesson plan
- Indicate ecological practices featured
- Outline human dimensions to discuss in lecture and lab on topic
- Make students aware of biological cross-cutting themes connected to lesson's core ecological concept
- 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

Course Transformation Pathway

START: 1) Assess your current course's lesson coverage of each of the four dimensions

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) for 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*

4DEE Framework

Core Ecological Concepts (CEC)	Ecology Practices (EP)	Human-Environment Interactions (HEI)	Cross-Cutting Themes (CCT)
• Organisms • Populations • Communities • Ecosystems • Landscapes • Biome • Biosphere	• Natural history • Fieldwork • Designing, conducting, and critiquing investigations • Quantitative reasoning and computational thinking • Data analysis and interpretation • Working collaboratively • Communicating and applying ecology	• Human interdependence with the environment • Human impacts on the environment from local to global scales • Ecological Ethics	• Structure & Function • Pathways & Transformations of Matter and Energy • Systems • Evolution • Space & Time

Example 1: Environmental distribution pattern activity

CEC: 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.
EP: Data analysis and interpretation, figure construction and presentation
HEI: Connection of tropical tree distribution patterns to timber harvesting practices in tropical forests, and impact on greenhouse gas emissions, weather.
CCT: Comparing impact of different timber harvesting practices on the system's energy transformation capabilities of tropical forests

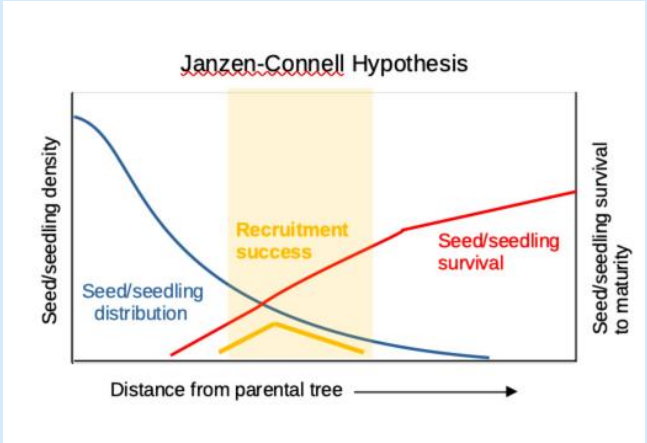

Diagram created by George Middendorf, Howard University.

Example 2: Wetland delineation activity

CEC: Individuals, populations, communities, ecosystems, landscapes all pertain to wetlands
EP: Natural history, fieldwork, quantitative reasoning, and collaboration can apply to wetlands. Students learn marketable skills by interpreting maps and identifying wetlands
HEI: Wetlands benefit society; humans have disturbed wetlands
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 involves 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