Backwards Design, Ecology, and Weaving a Course with HHMI BioInteractive Resources

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Introduction:

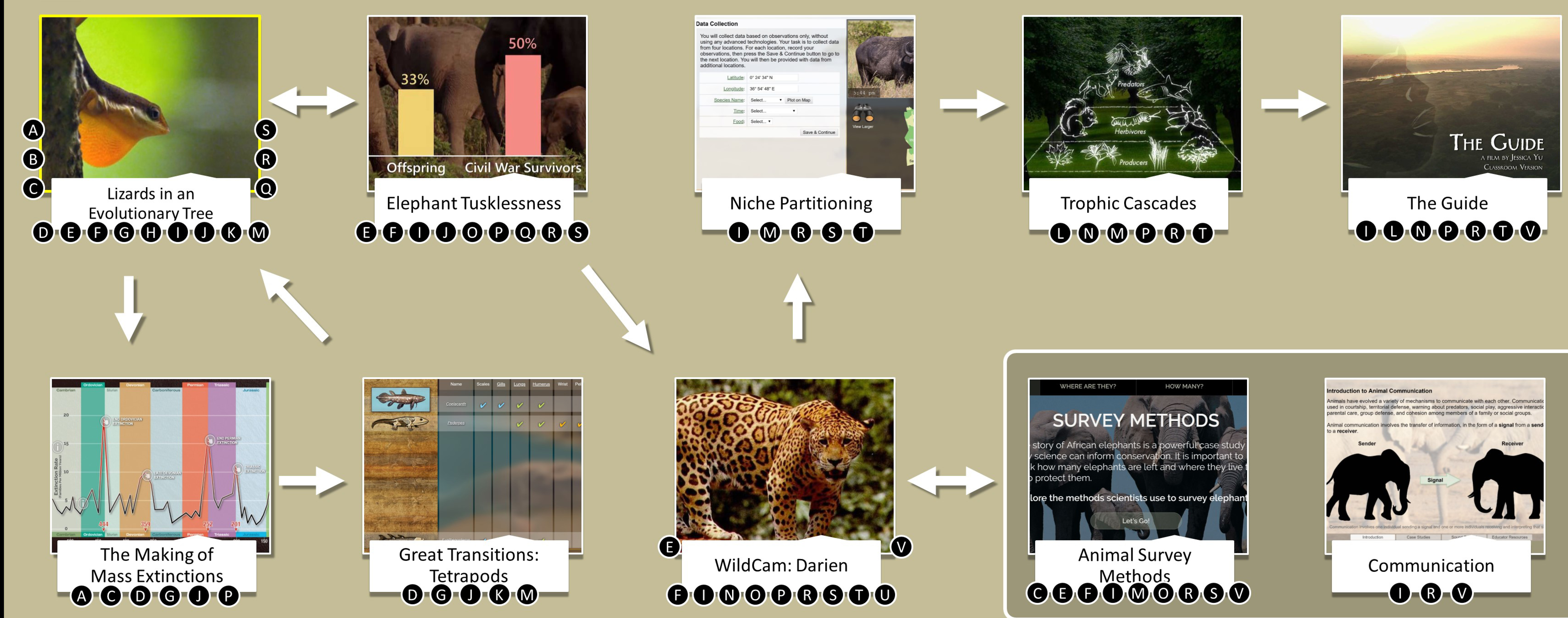
Backwards course design was used in an undergraduate introductory field ecology course to better align course goals, learning objectives, and assessments. The course is now flipped; in-class sessions are optimized for active learning and data-centric lessons. Various themes are used as touchstones for students to return to: evolution, natural selection, biodiversity, and conservation. Because of the richness and active nature of the resources, a variety of HHMI BioInteractive's activities are woven throughout the course to help students visualize and analyze the phenomena being discussed.

1 Define Course Learning Goals:

Provide students with an understanding of basic ecological principles including the:

- constant change of Earth and species over time;
- natural course of extinction versus present events;
- processes of adaptation, natural selection, mutation, genetic drift, and evolution;
- interactions of organisms with biotic and abiotic environment;
- change in ecological communities over time;
- measures of biodiversity and complexity;
- relationship of ecology and (wicked) environmental issues.

4 Design Lessons and Learning Activities:



2 Identify Measurable Objectives (Selection):

A. Utilize the scientific method to investigate a question;
B. Define ecology, population, community, and ecosystem;
C. Compare and contrast ecology to the other natural and physical sciences;
D. Compare and contrast various major kingdoms' adaptations to the environment;
E. Identify experimental error and suggest solutions;
F. Analyze how abiotic components of an ecosystem affect the biotic components and vice versa;
G. Properly carry out population and community structure sampling and analysis, qualitatively and quantitatively, both in model form and in the field.;
H. Distinguish between the payouts, tradeoffs, and consequences of both sexual and asexual reproduction;
I. Analyze the various types of species interactions that occur within communities;
J. Explain the relationship between adaptation and evolution;
K. Identify how mutations, genetic drift, and natural selection can all result in evolution;
L. Explain succession;
M. Discuss the factors of population growth and examine the factors resulting in populations going extinct;
N. Identify, analyze, and discuss the major causes of global environmental change, their impact on life, and possible solutions;
O. Summarize the types of population distribution;
P. Describe the importance and history of interpretive science in ecology;
Q. Apply population genetics to a real-world model;
R. Explain the importance of field, laboratory, and mesocosm experiments in ecology;
S. Interpret and draw appropriate conclusions from the analysis of data sets in the field and from models;
T. Compare and contrast the various processes that form communities;
U. Compare and contrast the major ecosystems of New England and the planet;
V. Describe the role of ecology in conservation methods.

3 Align Assessments:

This course uses multiple measures for assessment including:

- in-class projects/activities;
- active flipped homework;
- field labs/reports;
- research writing;
- midterm/final exam;
- numerous quizzes.

Conclusion:

Because this has only been in place for less than 2 years, insufficient data has been collected to do a pre-/post-redesign statistical analysis. Students, however, are doing at least as well as former classes in terms of midterm and final grades achieved (using similar assessments) in addition to the quality of their quizzes and writing assignments.

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