

# Symposium Proposal

The missing piece of the evolution-education puzzle: Teaching phylogenetics at introductory undergraduate and precollege levels

David A. Baum,  
Dept. of Botany, University of Wisconsin, Madison WI

and

Samuel S. Donovan,  
Dept. of Instruction and Learning, School of Education, University of Pittsburgh, PA

## Rationale

Evolution is first and foremost about descent from common ancestry and, thus, it is virtually impossible to think clearly about evolution without utilizing “tree-thinking.” In contrast to the great attention that has been focuses in recent years on the teaching of natural selection, virtually no attention has been paid to the teaching of phylogenetics. In order to take advantage of evolution as an organizing framework for understanding the unity and diversity of life and to be able to think clearly about the relationships between taxonomic groups, biology students must adopt a descent with modification perspective. Additionally, across biological disciplines from ecology to genomics, there is a growing emphasis on understanding the role of phylogenetic relationships in the interpretation of comparative data. The premise of this symposium is that evolution, and hence biology as a whole, cannot be taught properly without explicitly addressing the interpretation of phylogenies. Further, to effectively teach tree-thinking we need to know more about the common misconceptions that students have and the curricular tools that are available to help students develop a robust scientific understanding of descent with modification. Given the relative youth of phylogenetic systematics, and the paucity of research into students understanding of phylogenies, it is imperative that academic scientists take a leading role in educating undergraduates and especially future and present K-12 teachers. Our specific aims for this symposium are:

- 1) To clarify and refine the claim that tree-thinking should play a central role in the teaching of evolutionary biology at the college and precollege levels
- 2) To present educational research on the problems students face in understanding phylogenies
- 3) To present some novel curricular materials that can be useful
- 4) To highlight the leadership role that academic scientists should be playing in training future K-12 teachers in introductory biology classes at college and current K-12 teachers through the development of conceptual arguments, curricular materials and outreach activities.

## Proposed speakers (25 minutes each)

**David A. Baum** (Professor, Dept. of Botany, Univ. of Wisconsin)

“The challenge of teaching tree-thinking: major misconceptions and their remedies”

David Baum has been teaching introductory college courses with a major phylogenetic component for eight years and has taught four workshops for high school biology teachers on integrating phylogenies into the high school biology classroom. Recently he has been conducting research on student misconceptions in phylogenetics and has developed new curricular materials.

**Samuel S. Donovan** (Asst. Professor, Dept. of Instruction & Learning, Univ. Pittsburgh)

“Reading topologies: A study of students' understanding of relationships displayed in trees”

Sam Donovan is a science educator and chair of the Society for the Study of Evolution education committee. This presentation will describe the results of research into how students interpret branching diagrams and the importance of this skill for other aspects of evolutionary reasoning.

**Susan Offner** (Biology Teacher, Lexington High School, MA)

“The advantages of using phylogenetic trees in biology teaching”

Sue Offner, an experienced biology teacher, has been integrating phylogenies into her curriculum since 1998. She has also written articles on the tree of life for American Biology Teacher and has mentored high school students doing phylogenetic science fair projects, several of whom have gone on to gain statewide recognition for their work.

**Michael J. Donoghue** (Professor, Dept. Ecology and Evolution, Yale University)

“Using phylogenies as a framework for ecology and biogeography”

Michael Donoghue has long been an advocate of using phylogenies to teach evolution. He has implemented this vision in undergraduate courses at Harvard and Yale. Additionally, as director of the Peabody Museum, he has been involved in outreach activities to K-12 schools in the Newhaven area.

**Kirsten Fisher** (Graduate student, Dept. Integrative Biology, Univ. of California,

Berkeley)

“Lessons from the tree of life: the use of language in teaching phylogenetics”

Kirsten Fisher will present insights emerging from her work through the Deep Gene Initiative to educate K-12 teachers in phylogenetics and through her connections to the UC Museum of Paleontology, which has developed the “Journey into Phylogenetic Systematics” tutorial.

**Jon C. Herron** (Lecturer, Dept. of Biology, Univ. of Washington)

“Simulation-based tutorials for teaching tree thinking”

Jon Herron has been teaching evolution at the University of Washington for eleven years and is coauthor of *Evolutionary Analysis*, a leading undergraduate text on evolution. He will present simulation software and tutorials he has developed for helping students learn phylogenetic reasoning.

Manda Clair Jost (Post-doc, Section of Integrative Biology, Univ. of Texas)

“Using trees to teach biodiversity”

Manda Clair Jost has a long-standing interest in teaching and has taught a workshop for high school teachers on the Tree of Life. With her post-doc advisor, David Hillis, she has thought about effective teaching of biodiversity at the college and precollege levels.