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Table 1. Building Trees: Teaching Timeline Week 1, Tree Building and Analysis

Activity	Description	Time	Notes
Preparation for Class - Students			
Phylogeny Pre-lab Homework	Students use the self-guided PowerPoint to reinforce lecture topics and introduce tree thinking concepts used in lab activity	~ 45 min	Found in Supporting Materials S2
Phylogeny Pre-lab Questions	Students read articles (16, 17) and use the pre-lab PowerPoint described above to complete these questions prior to the lab activity	~1-2 hours	Articles in references Pre-lab questions are provided in Supporting Materials S3
Preparation for Class - Instructors			
Prepare Crassulaceae morphology cards	Instructors should print and cut Crassulaceae plant images as a single notecard set per group	~30min	Provided as Supporting File S6 and S7
Prepare colored pipe-cleaners for demonstrating tree topologies	Instructors may use a pipe-cleaner teaching tool (15) to assist the discussion of pre-lab questions	~30min	Activity based on Halverson, 2010 in references. One pipe-cleaner set per student work group is also recommended
Install MEGA 5.0, FigTree, and RASP software programs & lesson documents onto Desktop	These three software programs are needed for the lab activities. They are available for free download (please see lesson plan for URLs) Specific lesson documents needed by students are: <ul style="list-style-type: none"> • S5 • S8 (part 1) • S10 • S11 • S12 (remove key) • S15 • S16 • S17 • S18 (remove key) 	~10 min per computer	Newer versions of MEGA are available; however, if a different version is used for this lab, some parameters may differ slightly. Note: RASP is not needed until the second week of the unit, but instructors may wish download now.
Lab Activity 1: Morphology			
Phylogeny Instructor PowerPoint (Part 1)	Review lecture provided in two sections based on lab activities below.	~15 minutes	Lecture PowerPoint slides with notes are in Supporting Materials S4
Lab Activity 1: Morphology Tree Building	Student-lead lab activity in groups	~30 minutes	Instructions for lab activity and using FigTree are provided in Supporting Materials S5
Continued on next page...			

Activity	Description	Time	Notes
Lab Activity 2: Molecular			
Phylogeny instructor PowerPoint (Activity 2) <i>Note: this is a continuation of the PowerPoint started above.</i>	Review lecture provided in two sections based on lab activities below.	~20 minutes	Lecture PowerPoint slides with notes are in Supporting Materials S4
Molecular tree building with MEGA	Students use MEGA to perform a phylogenetic analysis of both the same set of 10 species used on the morphological analysis and the same analysis using a set of 20 species. Approximately 10 minutes are included after completion of the activity for an instructor-led full-class review of MEGA findings.	~ 55 minutes	The following documents are required for this activity: <ul style="list-style-type: none"> • Molecular sequence alignment file for viewing is provided as S9 • Instructions for the in-class lab activity as S8 • S10 • S11 • In-class questions (S12. LabQuestionsWeek1&KEY) for assessment (see next)
Student lab worksheet	A worksheet designed to address critical elements of phylogenetic construction and analysis.	~50 minutes	Available, along with a key, in Supporting Materials S12

Table 2. Building Trees: Teaching Timeline Week 2, Biogeography

Activity	Description	Time	Notes
Assessment			
Tree thinking quiz	Students take this multiple-choice quiz individually as assessment on the first two activities. We recommend students take it without notes, but this is at the discretion of the instructor.	~30 minutes	Available along with key in Supporting Materials S13
Lab Activity 3: Biogeography			
Instructor PowerPoint for Biogeography	This presentation briefly introduces students to the field of biogeography as well as provides an outline for implementing this lab activity.	~10 minutes total	S14
Biogeography lab activity	Students use Maximum Likelihood (more robust and different from Parsimony in the first week) to infer a molecular-based phylogeny of 20 species created in MEGA and the program RASP for a historical reconstruction of Crassulaceae distributions.	~ 2.5 hours	The following documents are required for this activity: <ul style="list-style-type: none"> • Lab activity instructions provided as S15 (Part 2) and S16 • Molecular sequences as used in activity above: S11 • Spreadsheet with species distributions for RASP input in S17 • In-lab questions for assessment (see next)
Student worksheet questions	A new worksheet designed for the second week to address critical elements of phylogenetic analysis as it pertains to biogeography.	~50 minutes	Available with a key in Supporting Materials S18
Assessment			
<ul style="list-style-type: none"> • Student group worksheets (2) for each week of the unit. • Individual Tree-thinking quiz 	These assessments were described in the timeline above where needed.		