Case Study Tree Thinking Answers

Tree Thinking: An Introduction to Phylogenetic BiologyAssessing and Improving Student Understanding of Tree-thinkingPatterns of Thinking about Phylogenetic TreesEvolution Education Re-consideredProject Learning TreeTowards a Framework for Representational Competence in Science EducationThe Learning TreeInvestigating how Students Communicate Tree-thinkingThe Colorado School JournalUsing Manipulative Models to Develop Tree-thinkingEvolutionAn Investigation of Relationships Between Student Acceptance of Evolution, Tree-thinking, and Eye Movement Among Different Instructional InterventionsProject Learning TreeSustainable Development and Environment IIMiddle School JournalThe School News and Practical EducatorBulletin - University of Tennessee, Agricultural Experiment StationBulletinThe Public-school JournalThe School Arts Magazine David A. Baum Tyler A. Kummer Erin Rochelle Naegle Ute Harms Kristy L. Daniel Stanley I. Greenspan Carrie Jo Boyce Aaron Gove Donaven Camrick McLaurin Douglas Emlen Edward Austin Leone Wei Jun Yang University of Tennessee, Knoxville. Agricultural Experiment Station Pedro Joseph Lemos

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Tree Sustainable Development and Environment II Middle School Journal The School News and Practical Educator Bulletin – University of Tennessee, Agricultural Experiment Station Bulletin The Public–school Journal The School Arts Magazine *David A. Baum Tyler A. Kummer Erin Rochelle Naegle Ute Harms Kristy L. Daniel Stanley I. Greenspan Carrie Jo Boyce Aaron Gove Donaven Camrick McLaurin Douglas Emlen Edward Austin Leone Wei Jun Yang University of Tennessee, Knoxville. Agricultural Experiment Station Pedro Joseph Lemos*

baum and smith both professors evolutionary biology and researchers in the field of systematics present this highly accessible introduction to phylogenetics and its importance in modern biology ever since darwin the evolutionary histories of organisms have been portrayed in the form of branching trees or phylogenies however the broad significance of the phylogenetic trees has come to be appreciated only quite recently phylogenetics has myriad applications in biology from discovering the features present in ancestral organisms to finding the sources of invasive species and infectious diseases to identifying our closest living and extinct hominid relatives taking a conceptual approach tree thinking introduces readers to the interpretation of phylogenetic trees how these trees can be reconstructed and how they can be used to answer biological questions examples and vivid metaphors are incorporated throughout and each chapter concludes with a set of problems valuable for both students and teachers tree thinking is must have textbook for any student seeking a solid foundation in this fundamental area of evolutionary biology

evolution is the unifying theory of biology the importance of understanding evolution by those who study the origins diversification and diversity life cannot be overstated because of its importance in addition to a scientific study of evolution many researchers have spent time studying the acceptance and the teaching of evolution phylogenetic systematics is the field of study developed to understand the evolutionary history of organisms traits and genes tree thinking is the term by which we identify concepts related to the evolutionary history of organisms it is vital that those who undertake a study of biology be able to understand and interpret

what information these phylogenies are meant to convey

this collection presents research based interventions using existing knowledge to produce new pedagogies to teach evolution to learners more successfully whether in schools or elsewhere success here is measured as cognitive gains as acceptance of evolution or an increased desire to continue to learn about it aside from introductory and concluding chapters by the editors each chapter consists of a research based intervention intended to enable evolution to be taught successfully all these interventions have been researched and evaluated by the chapters authors and the findings are presented along with discussions of the implications the result is an important compendium of studies from around the word conducted both inside and outside of school the volume is unique and provides an essential reference point and platform for future work for the foreseeable future

this book covers the current state of thinking and what it means to have a framework of representational competence and how such theory can be used to shape our understanding of the use of representations in science education assessment and instruction currently there is not a consensus in science education regarding representational competence as a unified theoretical framework there are multiple theories of representational competence in the literature that use differing perspectives on what competence means and entails furthermore dependent largely on the discipline language discrepancies cause a potential barrier for merging ideas and pushing forward in this area while a single unified theory may not be a realistic goal there needs to be strides taken toward working as a unified research community to better investigate and interpret representational competence an objective of this book is to initiate thinking about a representational competence theoretical framework across science educators learning scientists practitioners and scientists as such we have divided the chapters into three major themes to help push our thinking forward presenting current thinking about representational competence in science education assessing representational competence within learners and using our understandings to structure instruction

discusses how to identify and analyze missing developmental steps that can lead to learning problems utilizing the metaphor of a tree to examine how children perceive the world grow socially and academically and develop the ability to read write organize their work perform mathematics and more

learning is often an active endeavor that requires students work at building conceptual understandings of complex topics personal experiences ideas and communication all play large roles in developing knowledge of and understanding complex topics sometimes these experiences can promote formation of scientifically inaccurate or incomplete ideas representations are tools used to help individuals understand complex topics in biology one way that educators help people understand evolutionary histories of organisms is by using representations called phylogenetic trees in order to understand phylogenetics trees individuals need to understand the conventions associated with phylogenies my dissertation supported by the tree thinking representational competence and word association frameworks is a mixed methods study investigating the changes in students tree reading representational competence and mental association of phylogenetic terminology after participation in varied instruction participants included 128 introductory biology majors from a mid sized southern research university participants were enrolled in either introductory biology i where they were not taught phylogenetics or introductory biology ii where they were explicitly taught phylogenetics i collected data using a pre and post assessment consisting of a word association task and tree thinking diagnostic n 128 additionally i recruited a subset of students from both courses n 37 to complete a computer simulation designed to teach students about phylogenetic trees i then conducted semi structured interviews consisting of a word association exercise with card sort task a retrospective pre assessment discussion a post assessment discussion and interview questions i found that students who received explicit lecture instruction had a significantly higher increase in scores on a tree thinking diagnostic than students who did not receive lecture instruction students who received both explicit lecture instruction and the computer simulation had a

higher level of representational competence and were better able to understand abstract style phylogenetic trees than students who only completed the simulation students who received explicit lecture instruction had a slightly more scientific association of phylogenetic terms than students who received did not receive lecture instruction my findings suggest that technological instruction alone is not as beneficial as lecture instruction page ii

it is well known that students often struggle with tree thinking a core aspect of evolutionary education scientists consider phylogenetic trees multidimensional hypotheses of evolutionary relationships however student view textbook diagrams as static two dimensional images physical manipulatives have been used to facilitate learning science content in areas such as genetics but these instructional tools have not yet been tested in tree thinking in order to circumvent students tree thinking struggles i investigated the use of manipulative three dimensional tree models in an introductory biology course designed for non science majors n 163 specifically my research questions included what are the differences in tree thinking learning gains when exposed to one of three instructional treatment groups how do students interact with manipulative tree models i compared three treatment groups across three semesters 1 control 2 multichromatic model and 3 monochromatic model i used a mixed methods approach gathering data from pre post assessments course observations and student reflections to measure student tree thinking learning gains and interactions i found that students had the highest tree thinking learning gains when given explicit instruction tied with a multichromatic model f 2 160 15 608 p

explore how evolution shapes life from viruses to ecosystems with emlen and zimmer s engaging fourth edition of evolution making sense of life complete with updated examples and digital tools to support your learning

evolution is the unifying theme for the field of biology and is one of the most well developed and supported scientific theories to

date although overwhelming evidence exists supporting evolution evolution is considered a socio scientific issue socio scientific issues are potentially controversial social issues stemming in science content for example climate change stem cell research and the concept of life are also current socio scientific issues unfortunately given the potential controversy a large amount of the public still rejects evolution in attempt to counter the controversy educate people and communicate the scientific basis for evolution biologists commonly use a diagram called the phylogenetic tree these diagrams represent hypothesized evolutionary relationships and learning how to accurately interpret and generate phylogenetic trees called tree thinking is a difficult task for learners previous studies have investigated the relationship between tree thinking and evolution acceptance but these results were based on an instrument limited in reliability additionally these studies only incorporated a single integrated instruction method using a new instrument which quantitatively measures tree thinking and a reliable instrument which measures evolution acceptance i investigated the relationship between tree thinking learning outcomes and evolution acceptance in 884 undergraduate students from five different instructional interventions students completed the instruments both before and after learning about trees for one week of instruction i found a significant but weak correlation between evolution acceptance and student tree thinking learning i also found that in non majors biology students evolution acceptance only explains 1 4 of the variance found in learning about tree thinking knowing that students hold numerous misconceptions when interpreting phylogenetic trees i used eye tracking technology to investigate how these students visually interacted with these diagrams i found that students spend the most amount of time looking at the tips of trees that incorporate organisms more than trees that incorporate abstract letters my findings suggest that evolution acceptance does not significantly explain how students learn about phylogenetic trees additionally biometric data indicates that students do not interact with trees as expected with visual interactions closely aligned with expectations of common misconceptions

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