

## Phylogenetic Trees

How do the changes in gene sequences allow us to reconstruct the evolutionary relationships between related species?

### Why?

The saying "Don't judge a book by its cover," could be applied to the topic of evolution. For example, humans share 75% of their DNA with chickens. Biologists point to this as evidence that humans and chickens once shared a common ancestor. The advent of DNA technology has given scientists the tools with which to examine how closely related certain species are. DNA analysis allows scientists to construct phylogenetic trees whose branches link together the relatedness of different organisms.

### Model 1 – Phylogenetic Trees



1. Refer to Model 1.
  - a. How long ago did the common ancestor of all the organisms on this phylogenetic tree exist?  
35 mil.
  - b. Which two lines diverged 30 million years ago?  
bear and panda
  - c. List all modern descendants of the organism that was alive at the point indicated by the asterisk.  
every thing except  
black and polar

# Phylogenetic Tree Pogil Biology

**David A. Baum, Stacey D. Smith**



## **Phylogenetic Tree Pogil Biology:**

**Phylogenetics** E. O. Wiley, Bruce S. Lieberman, 2011-06-07 The long awaited revision of the industry standard on phylogenetics Since the publication of the first edition of this landmark volume more than twenty five years ago phylogenetic systematics has taken its place as the dominant paradigm of systematic biology It has profoundly influenced the way scientists study evolution and has seen many theoretical and technical advances as the field has continued to grow It goes almost without saying that the next twenty five years of phylogenetic research will prove as fascinating as the first with many exciting developments yet to come This new edition of *Phylogenetics* captures the very essence of this rapidly evolving discipline Written for the practicing systematist and phylogeneticist it addresses both the philosophical and technical issues of the field as well as surveys general practices in taxonomy Major sections of the book deal with the nature of species and higher taxa homology and characters trees and tree graphs and biogeography the purpose being to develop biologically relevant species character tree and biogeographic concepts that can be applied fruitfully to phylogenetics The book then turns its focus to phylogenetic trees including an in depth guide to tree building algorithms Additional coverage includes Parsimony and parsimony analysis Parametric phylogenetics including maximum likelihood and Bayesian approaches Phylogenetic classification Critiques of evolutionary taxonomy phenetics and transformed cladistics Specimen selection field collecting and curating Systematic publication and the rules of nomenclature Providing a thorough synthesis of the field this important update to *Phylogenetics* is essential for students and researchers in the areas of evolutionary biology molecular evolution genetics and evolutionary genetics paleontology physical anthropology and zoology

**Foundations of Phylogenetic Systematics** Johann Wolfgang Wägele, 2005 Phylogeny inference and the classification of organisms are indispensable for all fields of biology On the basis of a well corroborated tree of life it is possible to understand the evolution of structure and function of genomes of gene families of cascades of developmental genes and the origin of genes of medical importance Ecologists need a stable classification of organisms to identify organisms to find their correct names and thus further information on relevant species This book offers an introduction to the theory of *Phylogenetic Systematics* and is a companion for all biologists who want to analyze morphological or molecular data with classical methods or with modern computer programs The first part of the book explains the epistemological basis that is independent of the type of method used to construct phylogenetic trees Unlike other empirical sciences the estimation of data quality in phylogenetics is still little developed and very often neglected Here a theoretical basis is presented that enables the systematist to assess critically and objectively the quality of different data sets and to make statements on the plausibility of results This requires a conception of the notions of information content probability of homology probability of cognition probability of events the principle of parsimony the differentiation of phenomenological and modelling methods Willi Hennig's original method is compared with modern numerical systematics and an updated Hennigian procedure of data analysis is discussed The

difference between phenetic and phylogenetic cladistics is explained Popular tools for data evaluation implemented in computer programs are explained including their axiomatic assumptions sources of error and possible applications For the more common tools the mathematical background is explained in a simple easy to understand way Johann Wolfgang Wägele was until recently head of the Department for Animal Systematics Lehrstuhl für Spezielle Zoologie at the University of Bochum and is now director of the Museum Alexander Koenig in Bonn Germany His main research interests are the taxonomy phylogeny and biodiversity of Isopoda which implies observations of life history biogeography and ecology in combination with phylogeny inference Further subjects include arthropod phylogeny and tools for explorative data analyses The author is president of the Gesellschaft für Biologische Systematik a Central European society of systematists and he is actively promoting biodiversity research

*The Phylogenetic Handbook* Marco Salemi, Anne-Mieke Vandamme, 2003-08-27

Sample Text *Phylogenetic Supertrees* Olaf R.P. Bininda-Emonds, 2004-05-31 This is the first book on phylogenetic supertrees a recent but controversial development for inferring evolutionary trees Rather than analyze the combined primary character data directly supertree construction proceeds by combining the tree topologies derived from those data This difference in strategy has allowed for the exciting possibility of larger more complete phylogenies than are otherwise currently possible with the potential to revolutionize evolutionarily based research This book provides a comprehensive look at supertrees ranging from the methods used to build supertrees to the significance of supertrees to bioinformatic and biological research Reviews of many the major supertree methods are provided and four new techniques including a Bayesian implementation of supertrees are described for the first time The far reaching impact of supertrees on biological research is highlighted both in general terms and through specific examples from diverse clades such as flowering plants even toed ungulates and primates The book also critically examines the many outstanding challenges and problem areas for this relatively new field showing the way for supertree construction in the age of genomics Interdisciplinary contributions from the majority of the leading authorities on supertree construction in all areas of the bioinformatic community biology computer sciences and mathematics will ensure that this book is a valuable reference with wide appeal to anyone interested in phylogenetic inference

*Analysis of Phylogenetics and Evolution with R* Emmanuel Paradis, 2011-11-06 The increasing availability of molecular and genetic databases coupled with the growing power of computers gives biologists opportunities to address new issues such as the patterns of molecular evolution and re assess old ones such as the role of adaptation in species diversification In the second edition the book continues to integrate a wide variety of data analysis methods into a single and flexible interface the R language This open source language is available for a wide range of computer systems and has been adopted as a computational environment by many authors of statistical software Adopting R as a main tool for phylogenetic analyses will ease the workflow in biologists data analyses ensure greater scientific repeatability and enhance the exchange of ideas and methodological developments The second edition is completed updated covering the full gamut of

R packages for this area that have been introduced to the market since its previous publication five years ago There is also a new chapter on the simulation of evolutionary data Graduate students and researchers in evolutionary biology can use this book as a reference for data analyses whereas researchers in bioinformatics interested in evolutionary analyses will learn how to implement these methods in R The book starts with a presentation of different R packages and gives a short introduction to R for phylogeneticists unfamiliar with this language The basic phylogenetic topics are covered manipulation of phylogenetic data phylogeny estimation tree drawing phylogenetic comparative methods and estimation of ancestral characters The chapter on tree drawing uses R's powerful graphical environment A section deals with the analysis of diversification with phylogenies one of the author's favorite research topics The last chapter is devoted to the development of phylogenetic methods with R and interfaces with other languages C and C++ Some exercises conclude these chapters

**Molecular Evolution** Roderick D.M. Page, Edward C. Holmes, 2009-07-14 The study of evolution at the molecular level has given the subject of evolutionary biology a new significance Phylogenetic trees of gene sequences are a powerful tool for recovering evolutionary relationships among species and can be used to answer a broad range of evolutionary and ecological questions They are also beginning to permeate the medical sciences In this book the authors approach the study of molecular evolution with the phylogenetic tree as a central metaphor This will equip students and professionals with the ability to see both the evolutionary relevance of molecular data and the significance evolutionary theory has for molecular studies The book is accessible yet sufficiently detailed and explicit so that the student can learn the mechanics of the procedures discussed The book is intended for senior undergraduate and graduate students taking courses in molecular evolution phylogenetic reconstruction It will also be a useful supplement for students taking wider courses in evolution as well as a valuable resource for professionals First student textbook of phylogenetic reconstruction which uses the tree as a central metaphor of evolution Chapter summaries and annotated suggestions for further reading Worked examples facilitate understanding of some of the more complex issues Emphasis on clarity and accessibility **Phylogenetics** E. O.

Wiley, 1981-08-10 Presents a clear simple and comprehensive overview of the phylogenetic approach to systematics which has two major goals reconstructing the evolutionary relationships among organisms and integrating the results into general reference classifications Shows how the results of systematic research can be applied to studying the pattern and processes of evolution Tree Thinking: An Introduction to Phylogenetic Biology David A. Baum, Stacey D. Smith, 2012-08-10 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     Phylogeny Mike Steel,2016-09-29 Phylogenetics is a topical and growing area of research Phylogenies phylogenetic trees and networks allow biologists to study and graph evolutionary relationships between different species These are also used to investigate other evolutionary processes for example how languages developed or how different strains of a virus such as HIV or influenza are related to each other This self contained book addresses the underlying mathematical theory behind the reconstruction and analysis of phylogenies The theory is grounded in classical concepts from discrete mathematics and probability theory as well as techniques from other branches of mathematics algebra topology differential equations The biological relevance of the results is highlighted throughout The author supplies proofs of key classical theorems and includes results not covered in existing books emphasizes relevant mathematical results derived over the past 20 years and provides numerous exercises examples and figures

**Phylogenetic Trees and Molecular Evolution** David R. Bickel,2022-09-29 This book serves as a brief introduction to phylogenetic trees and molecular evolution for biologists and biology students It does so by presenting the main concepts in a variety of ways first visually then in a history next in a dice game and finally in simple equations The content is primarily designed to introduce upper level undergraduate and graduate students of biology to phylogenetic tree reconstruction and the underlying models of molecular evolution A unique feature also of interest to experienced researchers is the emphasis on simple ways to quantify the uncertainty in the results more fully than is possible with standard methods     **Phylogenetic Trees Made Easy** Barry G. Hall,2008 Barry G Hall helps beginners get started in creating phylogenetic trees from protein or nucleic acid sequence data     *Phylogenetic Analysis of DNA Sequences* Michael M. Miyamoto,Joel Cracraft,1991-11-14 With increasing frequency systematic and evolutionary biologists have turned to the techniques of molecular biology to complement their traditional morphological and anatomical approaches to questions of the historical relationship and descent among groups of animals and plants In particular the comparative analysis of DNA sequences is becoming a common and important focus of research attention today The objective of this volume is to survey the emerging field of molecular systematics of DNA sequences and to appraise the strengths and limitations of the different approaches yielded by these techniques The contributors are an internationally recognized group of investigators from different schools and disciplines who critically address a diversity of crucial questions about DNA systematics including DNA sequence data acquisition phylogenetic inference congruence and consensus problems limitations of molecular data and the integration of molecular and morphological data sets The work will interest all botanists and zoologists involved in systematics taxonomy and

evolution     **The Phylogenetic Handbook** Marco Salemi, Anne-Mieke Vandamme, Philippe Lemey, 2009-03-26 A broad hands on guide with detailed explanations of current methodology relevant exercises and popular software tools

**Phylogenetics and Ecology** Paul Eggleton, Richard I. Vane-Wright, Linnean Society of London, 1994-11-10 The relationship between systematics and ecology has recently been invigorated and developed a long way from the old field of comparative biology This change has been two fold Advances in phylogenetic research have allowed explicit phylogenetic hypotheses to be constructed for a range of different groups of organisms and ecologists are now more aware that organism traits are influenced by the interaction of past and present This volume discusses the impact of these modern phylogenetic methods on ecology especially those using comparative methods Although unification of these areas has proved difficult a number of conclusions can be drawn from the text These include the need for a working bridge between evolutionary biologists using logic based cladistic methods and those using probability based statistical methods for care in the selection of tree types for comparative studies and for systematists to attempt to analyse ecologically important groups Comparative ecologists and systematists need to come together to develop these ideas further but this volume presents a very useful starting point for all those interested in systematics and ecology     **Reconstructing the Tree of Life** Trevor R.

Hodkinson, John A.N. Parnell, 2006-12-26 To document the world s diversity of species and reconstruct the tree of life we need to undertake some simple but mountainous tasks Most importantly we need to tackle species rich groups We need to collect name and classify them and then position them on the tree of life We need to do this systematically across all groups of organisms and b

**The Timetree of Life** S. Blair Hedges, Sudhir Kumar, 2009-04-23 The evolutionary history of life includes two primary components phylogeny and timescale Phylogeny refers to the branching order relationships of species or other taxa within a group and is crucial for understanding the inheritance of traits and for erecting classifications However a timescale is equally important because it provides a way to compare phylogeny directly with the evolution of other organisms and with planetary history such as geology climate extraterrestrial impacts and other features The Timetree of Life is the first reference book to synthesize the wealth of information relating to the temporal component of phylogenetic trees In the past biologists have relied exclusively upon the fossil record to infer an evolutionary timescale However recent revolutionary advances in molecular biology have made it possible to not only estimate the relationships of many groups of organisms but also to estimate their times of divergence with molecular clocks The routine estimation and utilization of these so called time trees could add exciting new dimensions to biology including enhanced opportunities to integrate large molecular data sets with fossil and biogeographic evidence and thereby foster greater communication between molecular and traditional systematists They could help estimate not only ancestral character states but also evolutionary rates in numerous categories of organismal phenotype establish more reliable associations between causal historical processes and biological outcomes develop a universally standardized scheme for biological classifications and generally promote novel

avenues of thought in many arenas of comparative evolutionary biology This authoritative reference work brings together for the first time experts on all major groups of organisms to assemble a timetree of life The result is a comprehensive resource on evolutionary history which will be an indispensable reference for scientists educators and students in the life sciences earth sciences and molecular biology For each major group of organism a representative is illustrated and a timetree of families and higher taxonomic groups is shown Basic aspects of the evolutionary history of the group the fossil record and competing hypotheses of relationships are discussed Details of the divergence times are presented for each node in the timetree and primary literature references are included The book is complemented by an online database [www.timetree.net](http://www.timetree.net) which allows researchers to both deposit and retrieve data *Evolutionary Pathways in Nature* John C. Avise, 2006-05-04

Reconstructing phylogenetic trees from DNA sequences has become a popular exercise in many branches of biology and here the well known geneticist John Avise explains why Molecular phylogenies provide a genealogical backdrop for interpreting the evolutionary histories of many other types of biological traits anatomical behavioral ecological physiological biochemical and even geographical Guiding readers on a natural history tour along dozens of evolutionary pathways the author describes how creatures ranging from microbes to elephants came to possess their current phenotypes Essential reading for college students professional biologists and anyone interested in natural history and biodiversity this book is packed with fascinating examples of evolutionary puzzles from across the animal kingdom how the toucan got its enormous bill how reptiles grow back lost limbs and why Arctic fish don't freeze

**Data Integration, Manipulation and Visualization of Phylogenetic Trees** Guangchuang Yu, 2022-08-26 Data Integration Manipulation and Visualization of Phylogenetic Trees introduces and demonstrates data integration manipulation and visualization of phylogenetic trees using a suite of R packages tidytree treeio ggtree and ggtreeExtra Using the most comprehensive packages for phylogenetic data integration and visualization contains numerous examples that can be used for teaching and learning Ideal for undergraduate readers and researchers with a working knowledge of R and ggplot2 Key Features Manipulating phylogenetic tree with associated data using tidy verbs Integrating phylogenetic data from diverse sources Visualizing phylogenetic data using grammar of graphics

**Phylogenetics** Charles Semple, Mike Steel, Both in the Department of Mathematics and Statistics Mike Steel, 2003 Phylogenetics is the reconstruction and analysis of phylogenetic evolutionary trees and networks based on inherited characteristics It is a flourishing area of interaction between mathematics statistics computer science and biology The main role of phylogenetic techniques lies in evolutionary biology where it is used to infer historical relationships between species However the methods are also relevant to a diverse range of fields including epidemiology ecology medicine as well as linguistics and cognitive psychology This graduate level book based on the authors lectures at The University of Canterbury New Zealand focuses on the mathematical aspects of phylogenetics It brings together the central results of the field providing proofs of the main theorem outlines their biological significance and indicates how algorithms may be derived The

presentation is self contained and relies on discrete mathematics with some probability theory A set of exercises and at least one specialist topic ends each chapter This book is intended for biologists interested in the mathematical theory behind phylogenetic methods and for mathematicians statisticians and computer scientists eager to learn about this emerging area of discrete mathematics Phylogenetics in the 24th volume in the Oxford Lecture Series in Mathematics and its Applications This series contains short books suitable for graduate students and researchers who want a well written account of mathematics that is fundamental to current to research The series emphasises future directions of research and focuses on genuine applications of mathematics to finance engineering and the physical and biological sciences

*Phylogenetic Comparative Methods in R* Liam J. Revell, Luke J. Harmon, 2022-07-12 An authoritative introduction to the latest comparative methods in evolutionary biology Phylogenetic comparative methods are a suite of statistical approaches that enable biologists to analyze and better understand the evolutionary tree of life and shed vital new light on patterns of divergence and common ancestry among all species on Earth This textbook shows how to carry out phylogenetic comparative analyses in the R statistical computing environment Liam Revell and Luke Harmon provide an incisive conceptual overview of each method along with worked examples using real data and challenge problems that encourage students to learn by doing By working through this book students will gain a solid foundation in these methods and develop the skills they need to interpret patterns in the tree of life Covers every major method of modern phylogenetic comparative analysis in R Explains the basics of R and discusses topics such as trait evolution diversification trait dependent diversification biogeography and visualization Features a wealth of exercises and challenge problems Serves as an invaluable resource for students and researchers with applications in ecology evolution anthropology disease transmission conservation biology and a host of other areas Written by two of today s leading developers of phylogenetic comparative methods

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