# Chordate Snapshot An Interactive Phylogeny

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# Background

- •In biology, taxonomy is the systematic classifications of organisms into discreet groups that can be named and defined. Understandably, one of the largest difficulties of students newly introduced to taxonomy is the nature of what defines each group (Bilton 2014).
- •Difficulties students face when deciphering phylogenetic trees and taxonomy include:
  - Discerning the differences between taxa
  - •Understanding modern taxonomy consisting of a mix of morphology and genetics
  - •Determining the relatedness of living organisms and their evolutionary history
- A nested, interactive phylogenetic tree offers advantages like:
  - •Clearly showing the defining traits of each group
  - •Increasing or decreasing the scope of the tree at will
  - •Illustrating how clades fit "into" rather than "coming from" broader clades

# Methods

- •This application was created primarily using Go, Javascript, and the Javascript library D3.
  - •D3 is designed to allow for easy and interactive data visualization.
- •To coincide with the scope of those classes, the scope of the project was decided on Chordate biodiversity, down to level of "Order".
- •Phylogenetic hierarchy data was primarily retrieved from the Integrated Taxonomic Information System, or ITIS
- •Clade descriptions were created based on 42 independent sources, including text books, scientific journal articles, and encyclopedias.
- •Images of characteristic organisms were found using free for open use Google Image searches.
- •To visualize all included clades, the data was broken into 5 different subdivisions, with each division notated by a different colored node.

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# Chordata



Chordates are defined by a muscular postanal tail, a dorsal neural tube, an endostyle, pharyngeal gill slits, and most notably a notochord at some point in its development.

Rychel, A. L., Smith, S. E., Shimamoto, H. T., & Swalla, B. J. (2006). Evolution and development of the chordates: collagen and pharyngeal cartilage. Molecular biology and evolution, 23(3), 541-549.

B)

# Mammalia



Mammals are often considered the most diverse class of vertebrates on the planet. Though they are not the largest clade, they span worldwide and have incredibly diverse physical traits. All mammals, however, share several common traits. They are homeothermic endotherms, often referred to as being warmblooded, and all possess fur or hair to help insulate their body heat. They also possess two small inner ear bones, the malleus and the incus, which connect to the stapes to form a complicated and sensitive aural structure. They have heterodont dentition, meaning they have several tooth types in their jaws, and produce milk from mammary glands to sustain newborns. Mammals are generally very active, social, and comparatively intelligent, having complex social, reproductive, and feeding dynamics.

Liem, K. F., Bemis, W. E., Walker, W. F., & Grande, L. (2001). Functional anatomy of the vertebrates: an evolutionary perspective.

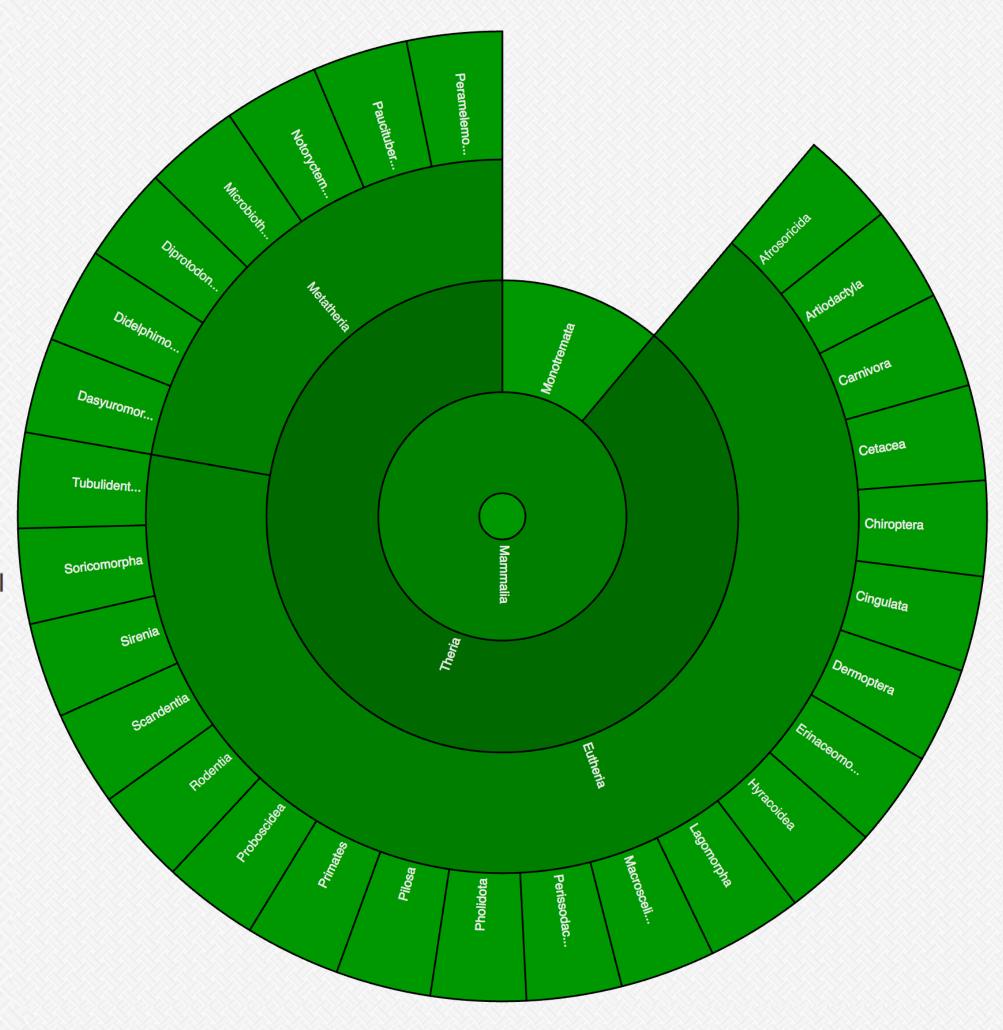


Figure 1). Images above show screenshots of the application at A). the broadest clade (Chordata) and B). one of the most specific clades, Mammalia.

# **Chordate Snapshot**What it is:

This is an interactive phylogenetic tree, showing every living chordate down to the order level. Each level of taxonomy shows you a description of the group, what kinds of animals are included, and some fun facts about the clade, along with an illustrative picture.

# How to use:

Click anywhere in a section to zoom to that level
Roll over the name of a group to see its details without zooming
Click the center circle to go back up a layer
Sections with distinctive colors are groups that go even deeper!

### Discussion

Student's main points of confusion on phylogenetic trees center around two issues: the interrelatedness of the species shown and the representation of time on a tree

Chordate Snapshot deals with these issues in several ways:

- 1. The nested nature of the application is important in understanding how these taxa are related.
  - •Students can tell how closely related two groups are related by looking for the most specific clade that encompasses both groups.
- 2. Focus is shifted away from evolutionary history towards the current state of living animals
  - Arranged so from inside to outside, the taxa get more specialized, and not more recent. This allows for students to see that birds did not evolve from reptiles, but that birds are a more specialized group of reptiles.

# Applications

- The Chordate Snapshot has a range of uses for many demographics, including:
  - Supplemental study material for college level biodiversity students, or advanced placement high school students.
  - Applications as an initial teaching tool, with an instructor using it as a roadmap for a "guided tour" of chordate taxonomy.
  - Taxonomy and phylogeny review for experienced biologists, both for clades they are familiar with, as well as less well known groups.

# **Future Steps**

- Student testing and surveying for possible improvements
- Optional increase in information depth, possibly to genus
- •Learning checks, such as a "Quiz Yourself" functionality
- Search functions for specific clades or species
- More media per group, including a photo album or videos
- Adding more information regarding evolutionary history

## References: