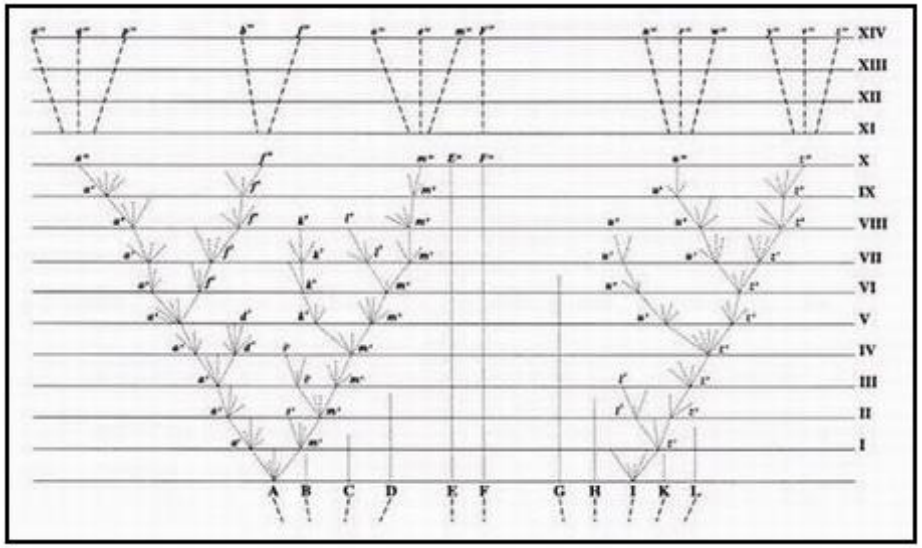
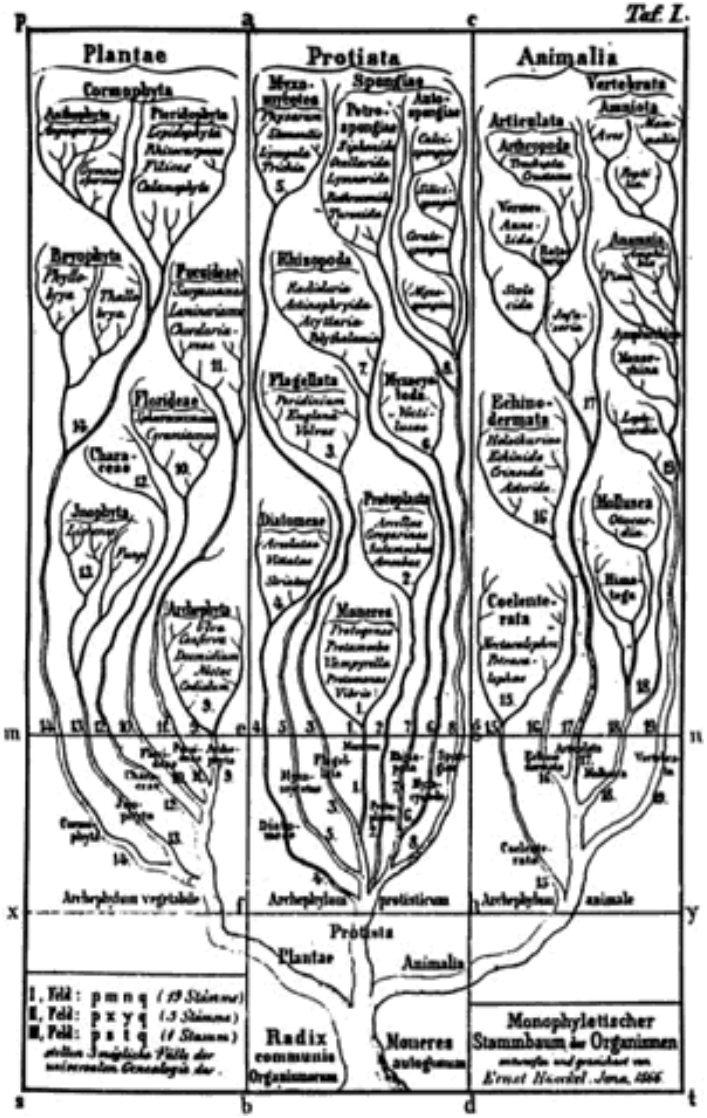
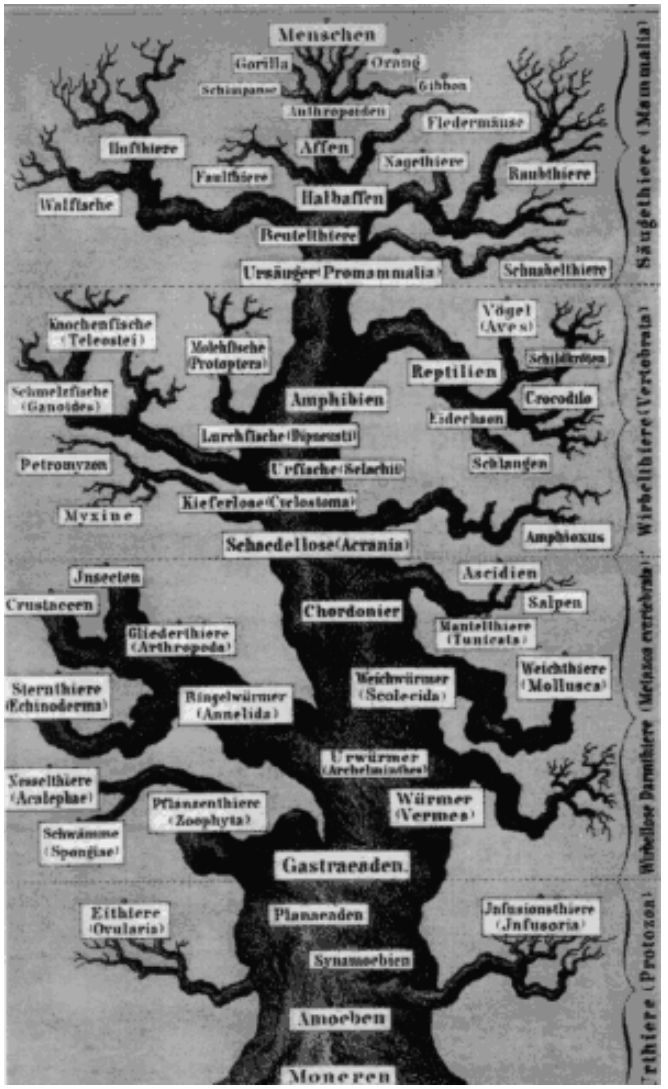
From Darwin's The Origin of Species



"…The affinities of all the beings of the same class have sometimes been represented by a great tree. I believe this simile largely speaks the truth. … so by generation I believe it has been with the great
Tree of Life…"

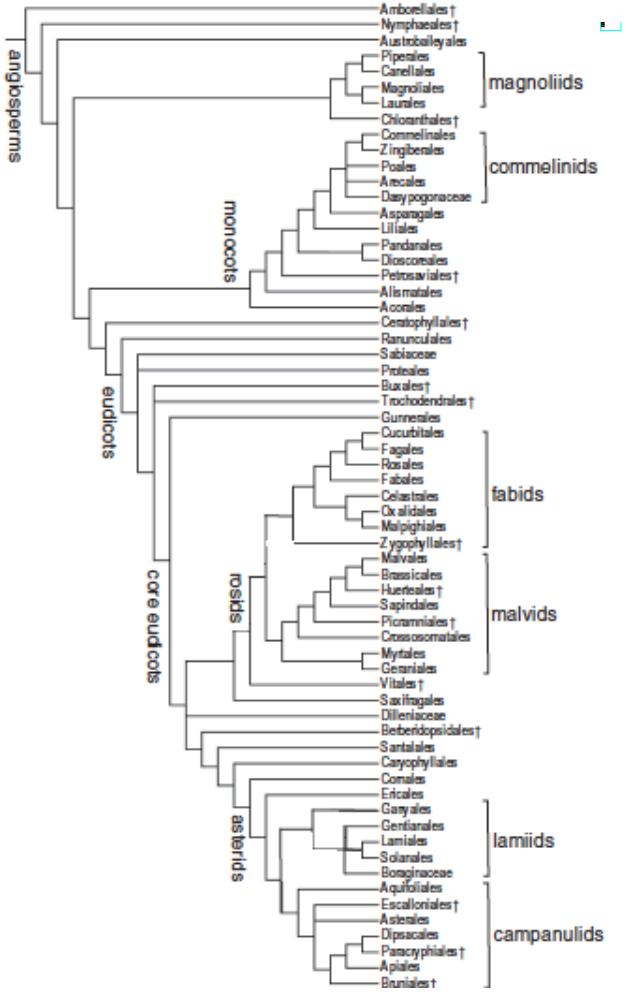
Haeckel's tree



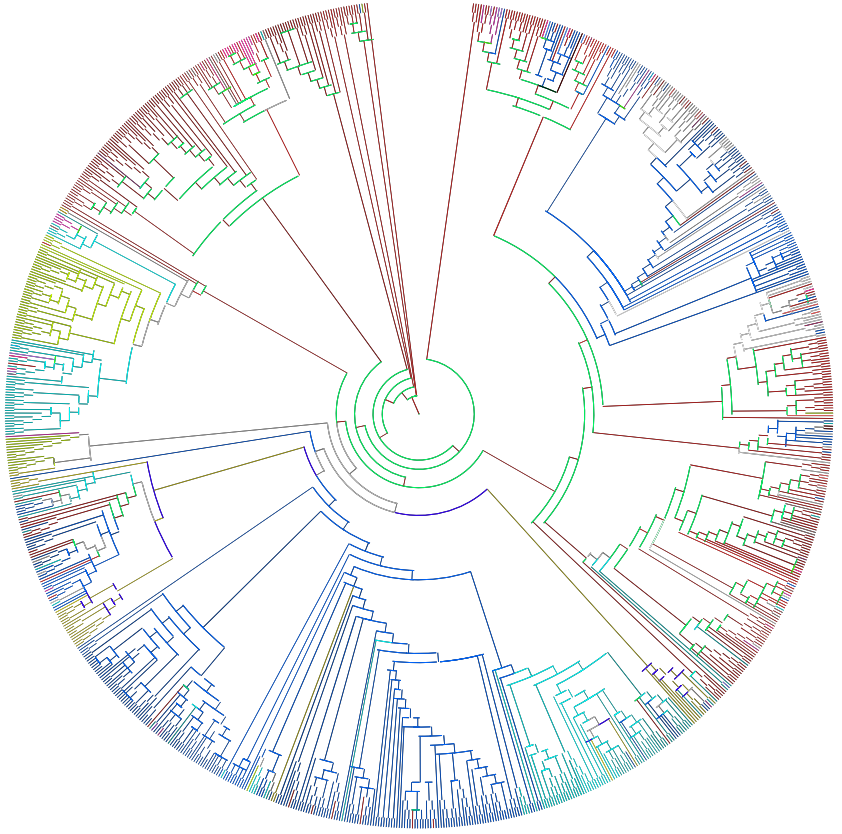


The German biologist Ernst Haeckel (1834 - 1919) was a noted scientific illustrator and the first great popularizer of Darwin's Theory of Evolution

We have come so far – so fast

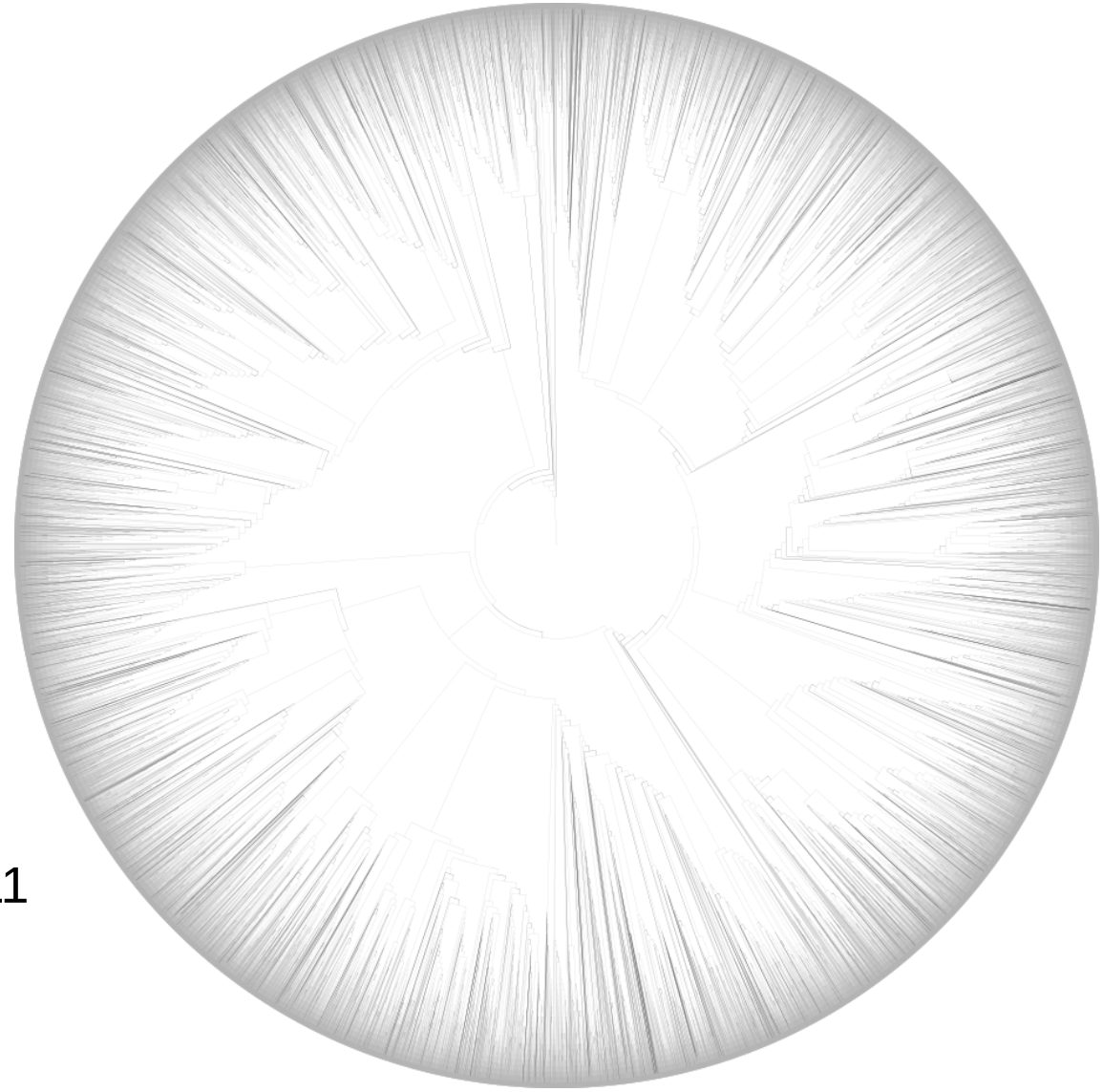


framework tree

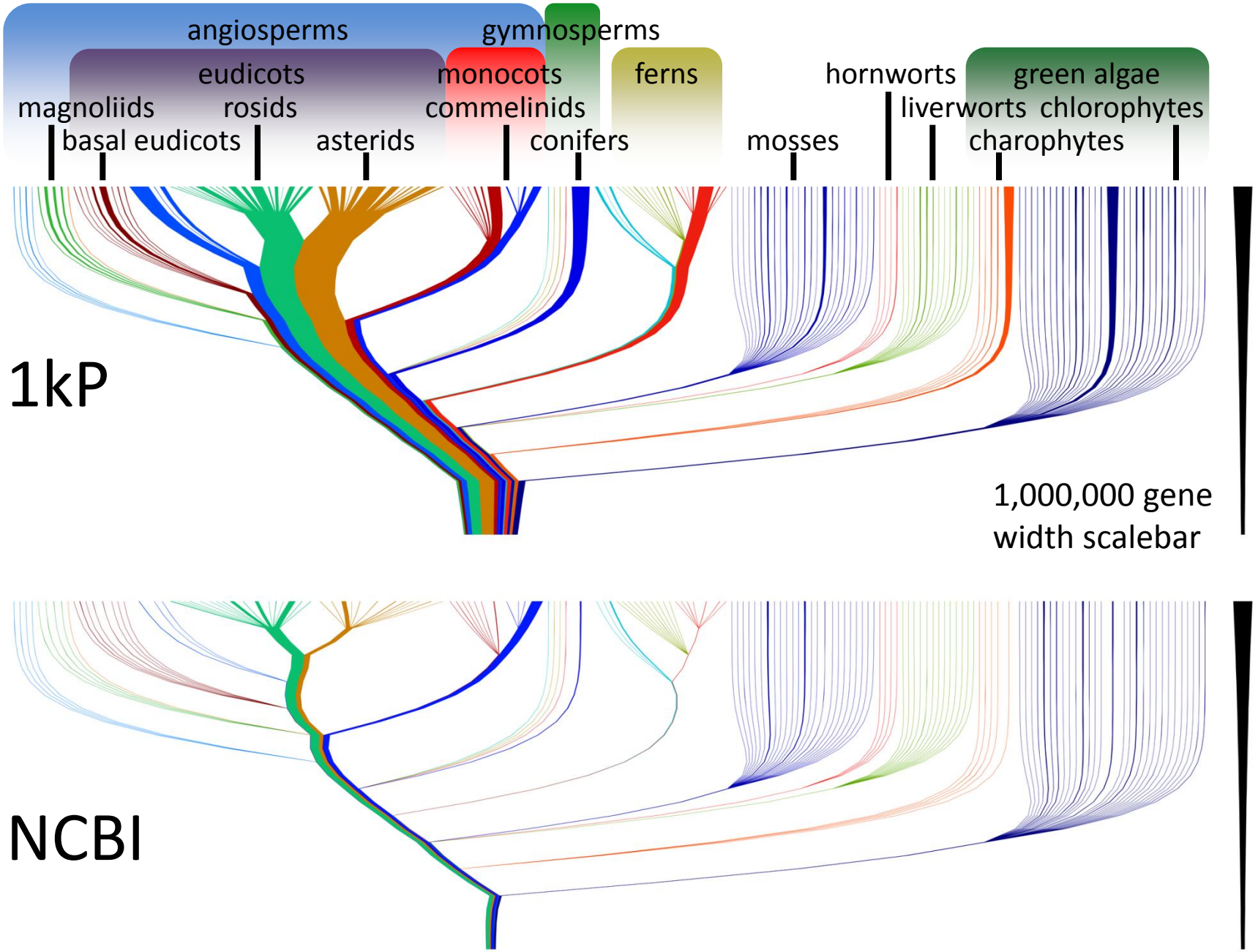


numerous taxa

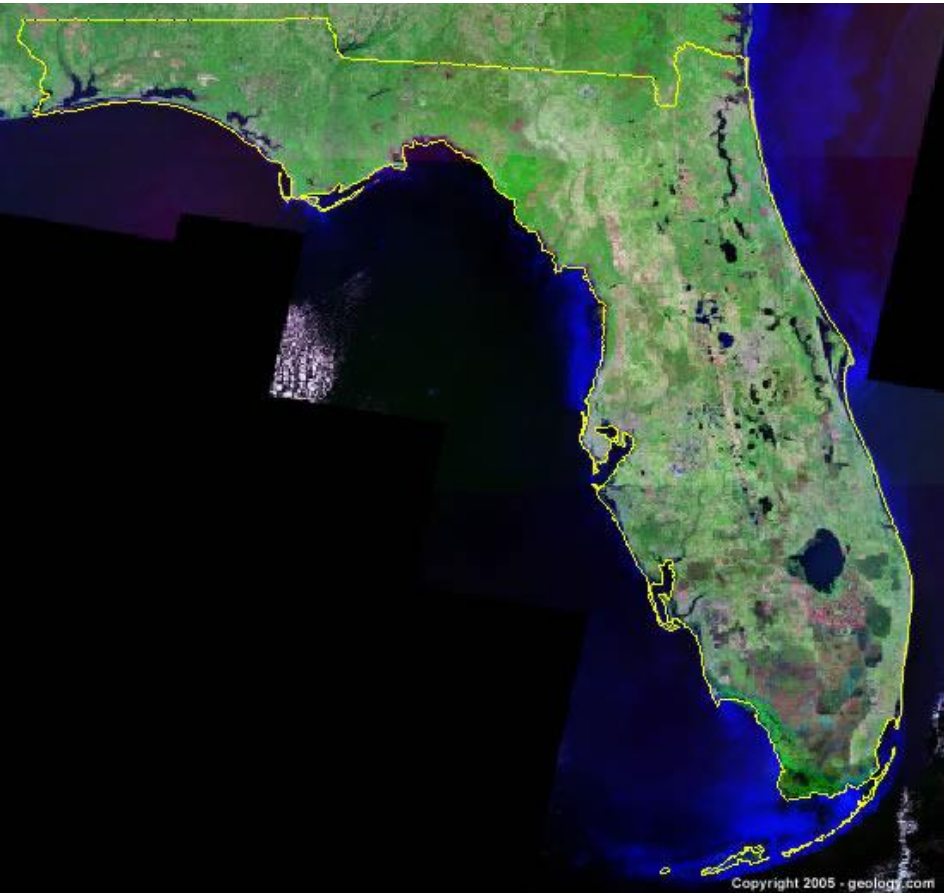
55,473 plant species: shifts in diversification rate

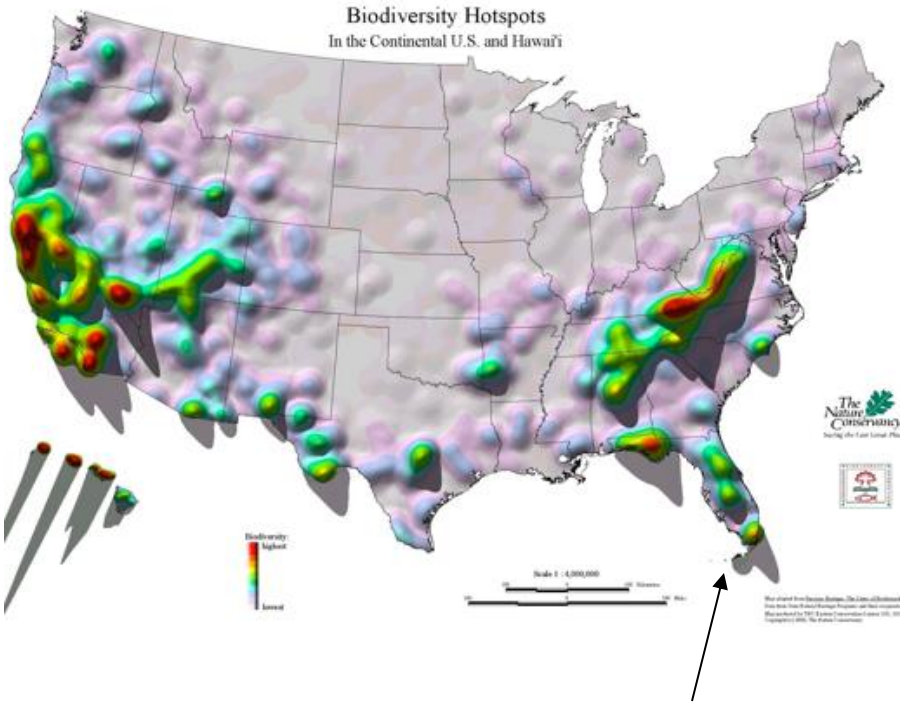


Smith et al. 2011


angiosperms
gymnosperms
eudicots
monocots
ferns
hornworts
green algae
magnoliids
rosids
commelinids
liverworts
chlorophytes
basal eudicots
asterids
conifers
mosses
charophytes
1kP
1,000,000 gene
width scalebar
NCBI

Florida Phylogeny Project





Soltis, D.; Soltis, P.; Burleigh, G.; Majure, L.; Neubig, K.; Abbot, R.; Allen, J.; Germain-Aubrey, C.

Why Open Tree of Life?

- Despite 150 years of effort, 55 AToL projects, and numerous other funded projects, we still lack a comprehensive ToL.
- Systematics currently emphasizes efforts on separate clades, and lacks a culture of grand synthesis.
- Despite the availability of repositories (GenBank, TreeBASE), most systematic knowledge is published in formats that prohibit the ready sharing and reuse of trees and data.
- Many undescribed species are being detected with environmental sequences, but there is no process for integrating these into the ToL.

OPEN Tree of Life
A community-assembled ToL

Objectives

- Within one year create a comprehensive first draft ToL that has all 1.8 million named species (include fossils)
- Enable and the community to subsequently annotate, modify and add to this tree by providing a suite of useful tools and by engaging in diverse outreach activities.
- Transform the culture and practices in systematics toward one of grand synthesis.

OPEN Tree of Life

This initial **tree of life will not be static**; instead, **we will develop tools for scientists** to update and revise the tree as **new data** come in.

Incentives for community involvement

- Design software to provide services that enhance workflows
- Facilitate rapid development of new, customized tools.
- Automated updating of the ToL---a perpetually-growing tree– this will facilitate the rapid discovery of new biodiversity
- Host workshops to engage the broader community.
- Provide resources for educators to teach about the ToL, and for students to contribute to the growth of the ToL.
- Development of the analytical tools that capture processes that shaped the deepest nodes on the tree of life
  - methods to infer species trees from individual gene trees
  - enable estimates of the lateral transfer events between major portions of the tree of life (e.g., microorganisms).

Transformative

- This tree will be provided in a flexible format that will be accessible to diverse communities.
- The starting point for community involvement and annotation.
- Enable the community--so the tree will continue to improve.
- Automatically placing environmental sequences onto the tree will dramatically accelerate the discovery of biodiversity.
- Transform how systematics is done
- The availability of the tree will impact much of biology.

- moon-shot for biodiversity studies.

Systematics Takes Its Moonshot

Outreach

1) **Overview of the Website, Content, and Interface**
    a. Website Goals
        i. The Open Tree of Life is intended to be an exemplary tree, which visually displays the relationships between known species.
        ii. The interactive nature of the tree will allow users to explore these relationships at their own pace and interest level.
        iii. The species selected for representation on the tree should meet one (or more) of the following criteria:
            1. Exemplify a specific concept necessary for understanding inter-species relationships (e.g, Lateral Gene Transfer).
            2. Be of interest to user group.
            3. Species that showcase early traits within evolutionary chain (early species examples).
            4. Species close to points of evolutionary diversion.
            5. Species that show interaction with human life (e.g., yeast to make wine/bread, infections, probiotics).
            6. Suggestions for additional criterion?
    b. Content
        i. 200-300 Species total across three domains
            1. Linked to Encyclopedia of Life directory.
            2. Possible compromise for species selection: Scientists select 200 species, design team select 100 for inclusion on tree.
        ii. 10-15 Explanatory Videos, each 20-30 seconds in length.
        iii. Online, interactive game component that encourages users to delve further into Open Tree of Life content to answer questions/obtain badges, etc.
    c. Interface
        i. Picture Grid with all species pictured that takes user to species location on tree when clicked and shows EoL integrated content
        ii. Visual "Tree" map that can be zoomed in on to show increasing detail (think Google Maps) with "picture in picture" box display of where user is currently looking on map

PUBLIC Tree of Life

A public resource for understanding how organisms are connected by the passage of genes along the branches of the phylogenetic Tree of Life.

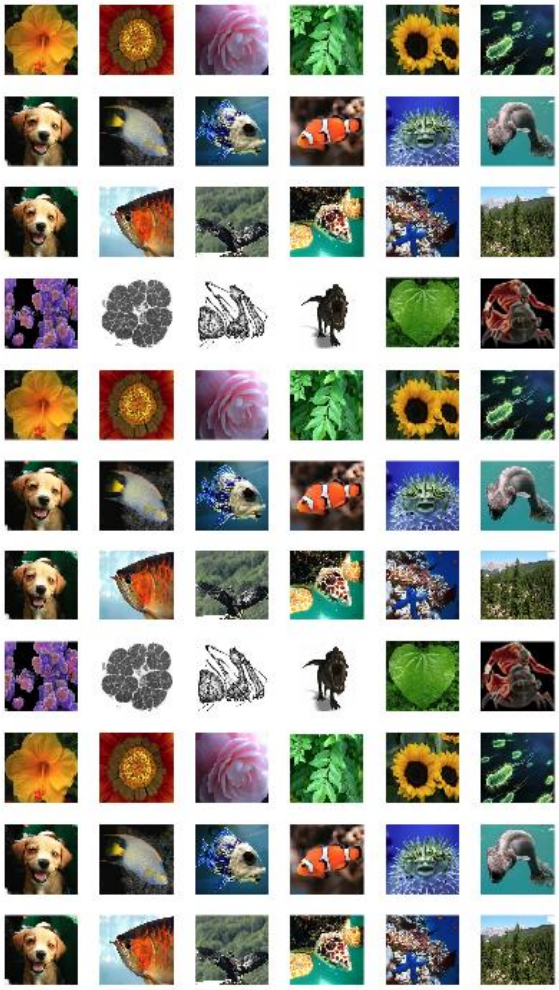
- What is the **Tree of Life**?
- Understanding **biodiversity**
- **Find it** on the Tree
- **Test** your knowledge

Roll over an organism to view it. **Click on it** to learn more and see its place on the tree.

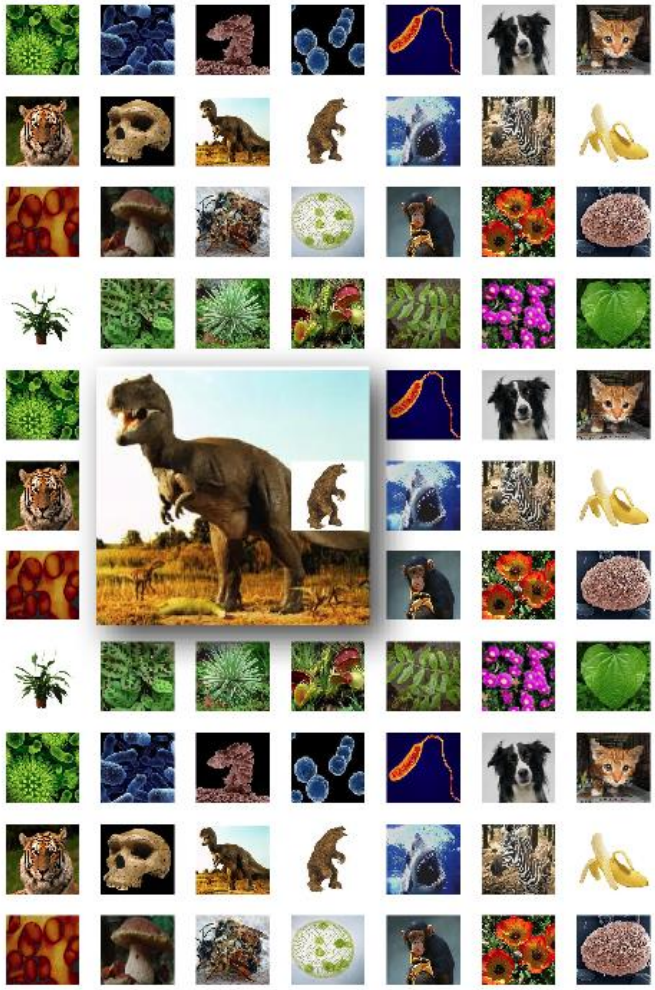
View page as:
A Grid
A Tree

Learn about OPEN Tree of Life

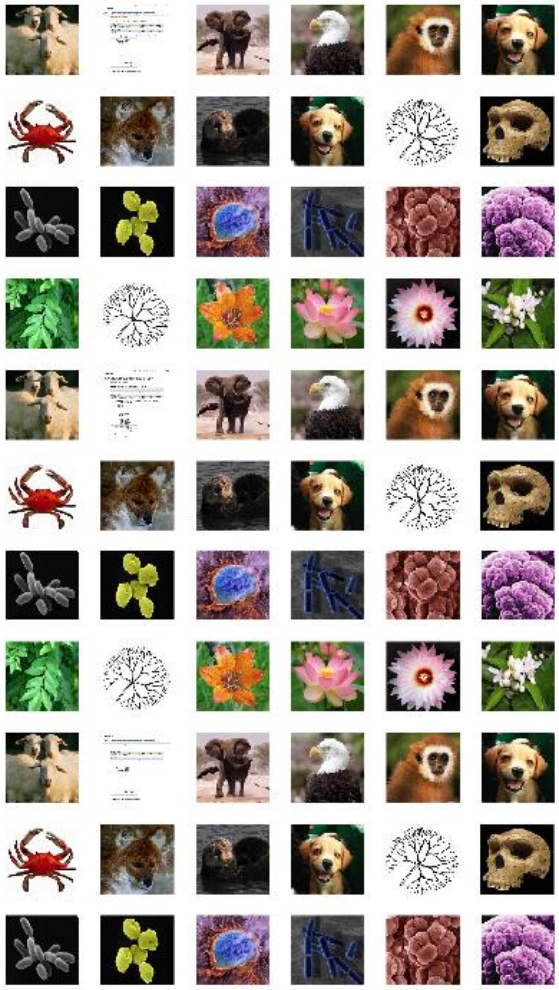
EUCHARYA



BACTERIA



ARCHAEA



EVOLUTION

Outreach

2) Descriptive Video Topics and their General Content

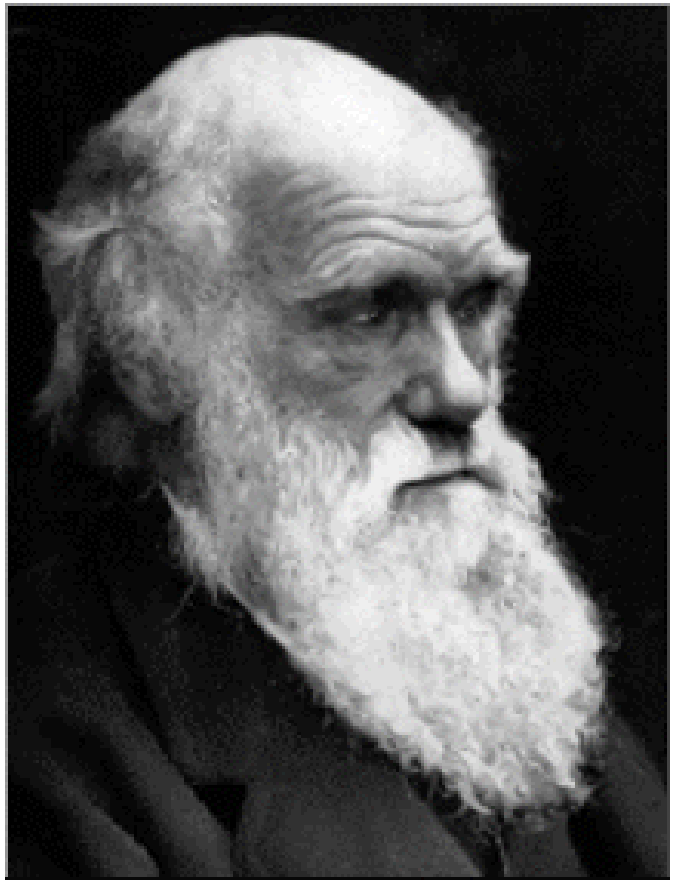
- Origin of Life
- Biodiversity
- Extinct Species
  - What does "extinct" really mean?
- Intro to Tree of Life (what is the Tree of Life?)
- Intro to Tree of Life website (opening video)
  - How to use website to explore Tree of Life
- Major Kingdoms
  - Overview of 3 main branches
  - Achaea
  - Eukaryotes
  - Bacteria
- Major distinctions between domains
- Common Ancestors
- Lateral Gene Transfer

Building the tree of life

- Recently funded
- Rough draft tree in 1 yr for all 1.8 million species
- Community exercise
- Tools (incentives) to allow researchers to edit (annotate) portions of the tree
- Wikipedia-like, but with many trees possible
- Outreach
  - Public version of the tree
  - Videos
  - Interactive games

… what took you so long?”

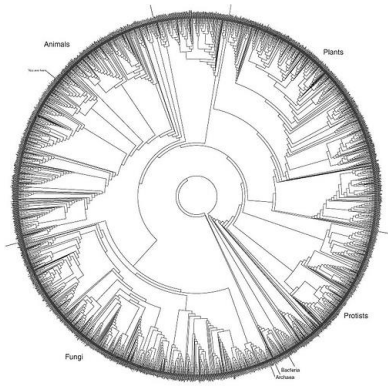
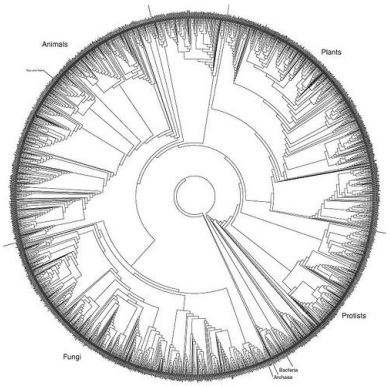
--Charles Darwin



OPEN
Tree of Life
A community-assembledToL

Open Tree

- Gordon Burleigh, University of Florida • Tiffani Williams, Texas A&M • Rick Ree, Field Museum
- Doug Soltis, University of Florida
- Mark Holder, University of Kansas
- David Hibbett, Clark University
- Keith Crandall, George Washington Univ.
- Stephen Smith, University of Michigan
- Karen Cranston, NESCent
- Laura Katz, Smith College
- Karl Guide, Michigan State University


Animals
Plants
Protists
Fungi
Bacteria
Archaea

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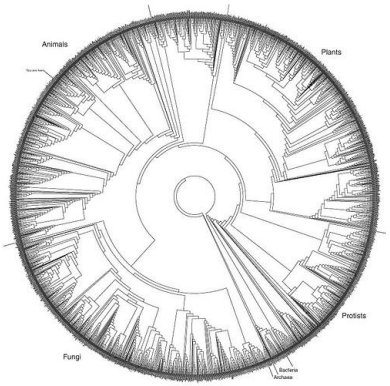
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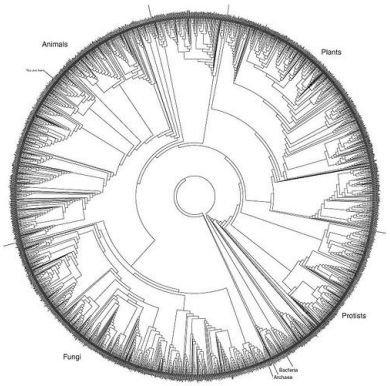
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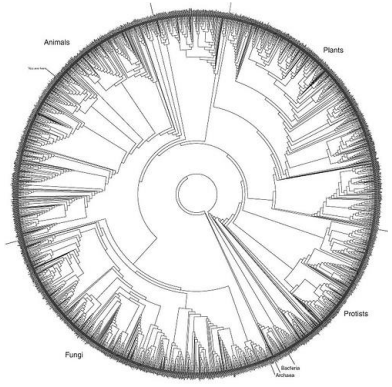
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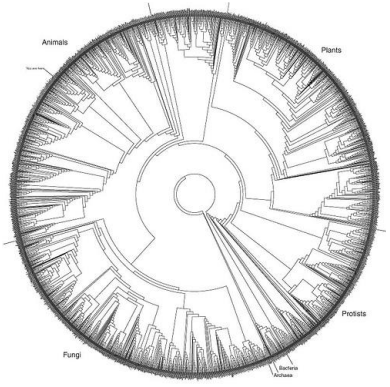
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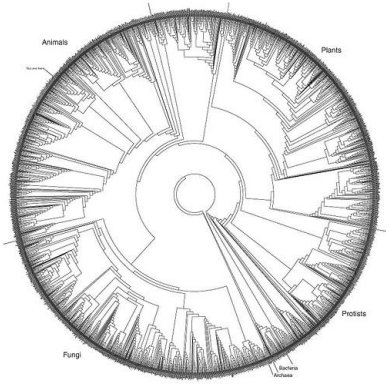
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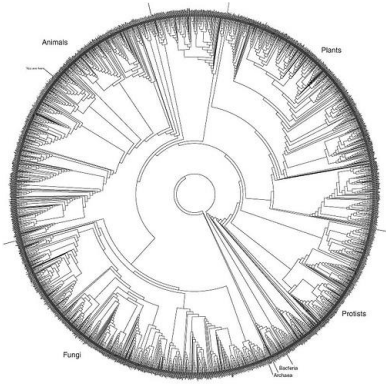
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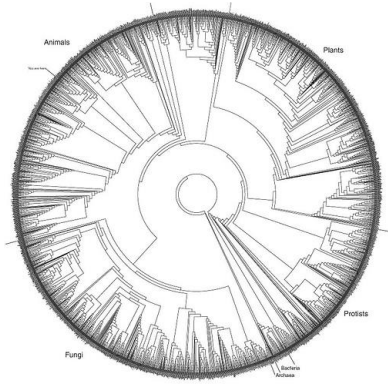
Animals
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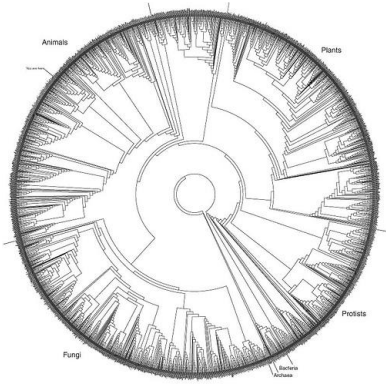
Protists
Fungi
Bacteria
Archaea

Thanks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Archaea

Open Tree: How do I do get involved?

- http://opentreeoflife.org/
- join our mailing list to participate in discussion
- suggest trees to incorporate into the Draft Tree
- follow the #opentree hashtag on Twitter

Do you want an app for this?

The developers of the Open Tree of Life would like to know from the phylogenetic community what kind of information they want to extract from its database when the first draft is released later this year.

With those preferences, it is possible to develop an API that gives scientists the opportunity to build their own websites or software packages that use the data.