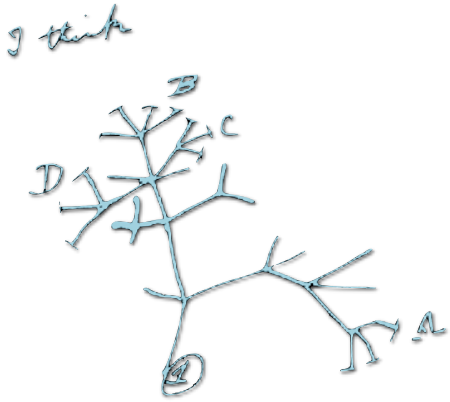
TREE OF LIFE

Chapter 2

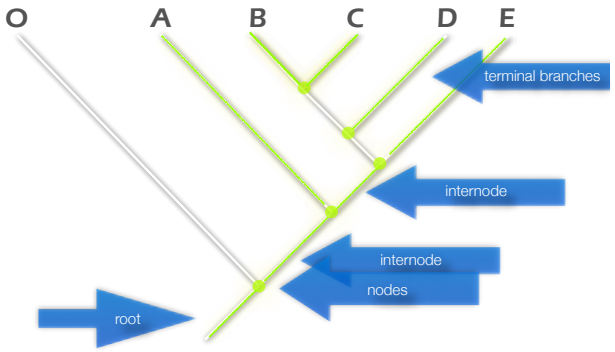
A TREE OF LIFE

- **common ancestors**
  - phylogenetic trees
  - LUCA - last universal common ancestor
  - family tree of organisms
- **who is related to whom?**



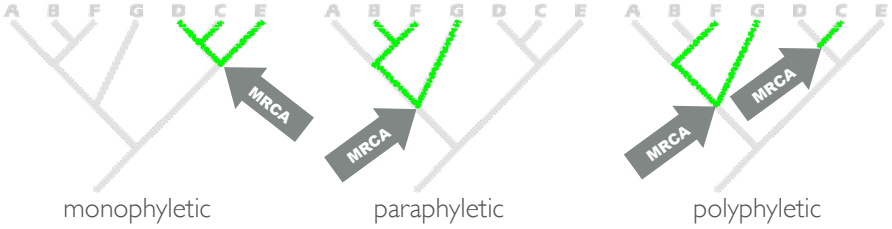
PHYLOGENETIC TREES

- **basic terminology**
  - root (MRCA)
  - node
  - internode
  - terminal branch
- **taxa**
  - species
  - higher taxa
  - sister taxa



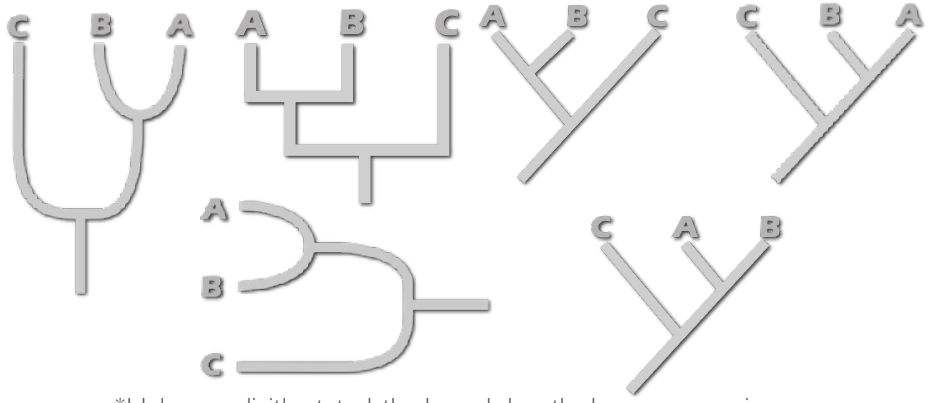
SYSTEMATICS

- **phylogenetic trees are used create taxa**
  - **monophyletic**
  - paraphyletic
  - polyphyletic



VISUALIZING TREES

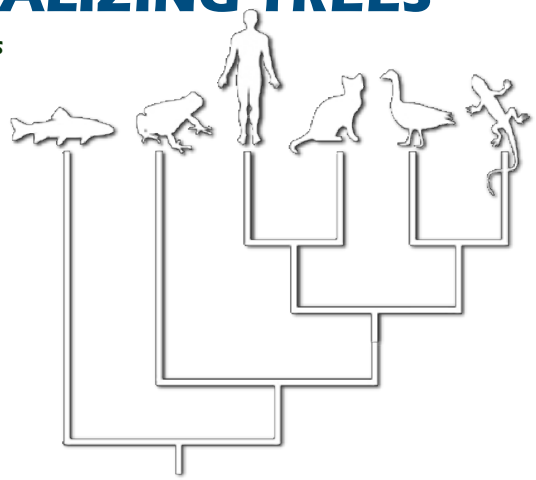
- **there are lots of equivalent ways to draw the same tree**



*Unless explicitly stated, the branch lengths have no meaning.

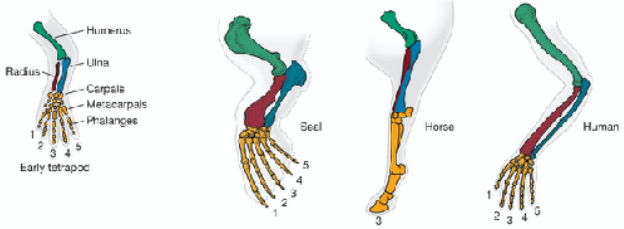
VISUALIZING TREES

- **understanding trees**

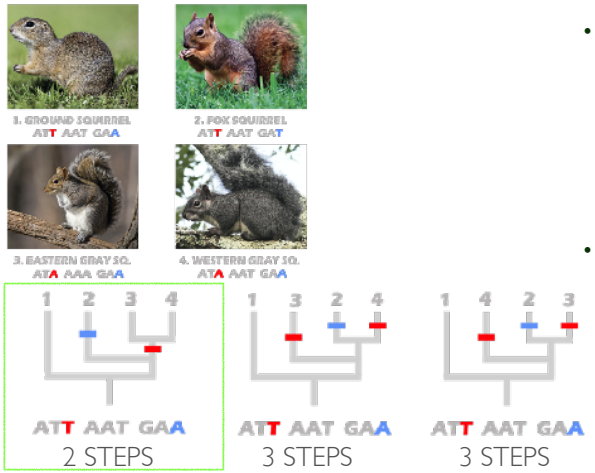


HOMOLOGY

- **characters**
  - character states/traits
  - can be morphological or molecular
    - fossil evidence
- **homology vs. analogy (homoplasy)**



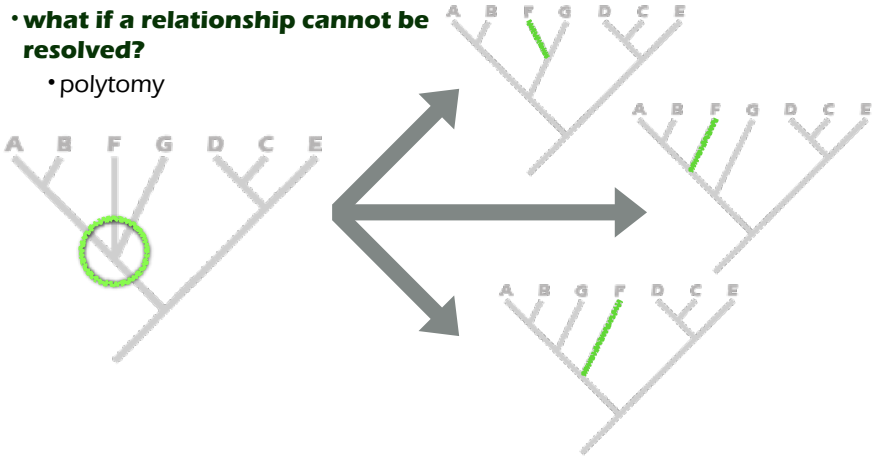
BUILDING TREES



- **outgroup**
  - an outgroup is some more distantly related taxon that is used to determine the plesiomorphic version of a character.
- **ingroup**
  - the group we are interested in.

POLYTOMIES

- **what if a relationship cannot be resolved?**
  - polytomy

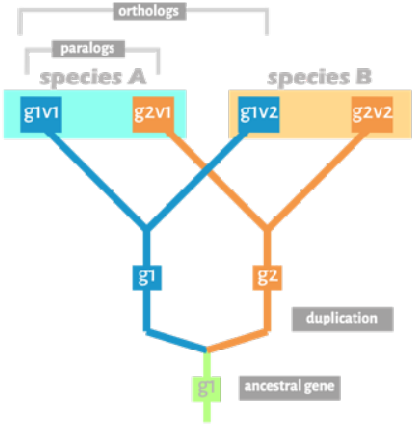


EXCEPTIONS

- **sometimes, weird things happen**
  - hybrid speciation
  - horizontal gene transfer

OTHER TYPES OF TREES

- **gene trees**
  - different genes have different trees
    - a gene tree may differ from a species tree
- **gene duplication -**
  - paralogs
  - orthologs



RELATIVE CHARACTER

characters

taxa	1	2	3	4	5
outgroup (Poecilia)	0	0	0	0	0
Eurycea	1	0	0	0	0
Hyla	1	0	1	0	0
Anolis	1	1	1	1	0
Parus	1	1	1	1	1
Homo	1	1	1	0	0

- **types of characters**
  - older characters
    - plesiomorphies
  - newer characters
    - apomorphies
      - synapomorphies
      - autapomorphies
- **mosaic evolution**
  - a species in an amalgamation of many plesiomorphic and apomorphic characters

INFERRING CHARACTER STATES

- **mapping characters onto phylogeny**
  - we can infer the character state for ancestors (parsimony)

characters

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outgroup (Poecilia)	0	0	0	0	0
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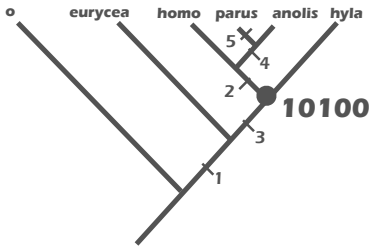
Anolis	1	1	1	1	0
Parus	1	1	1	1	1
Homo	1	1	1	0	0



PATTERNS

- **homoplasy**
  - analogous character states have evolved in many cases
    - convergence
    - parallel evolution
    - evolutionary reversal