

so we have seen that species are **real**  
 but how to **define** them is problematic.  
 a species' **specific** name **never changes**  
 though it may be **moved** to another genus.  
 there is a **hierarchy** of **similarity** from **descent**  
 ... but similarity depends upon **how we look**  
 we **classify** according to **perceived similarity**  
**classifications are provisional**

Characters contain information on biological relationships because.....

- characters are **inherited**
- because inheritance is imperfect, characters **change** through time
- more time  $\approx$  more change

**LEVELS OF RESEMBLANCE  
 BASED IN CLOSENESS OF DESCENT**

- therefore seems like with good info. on characters, we can make a perfect natural biological classification....  
 ...but there's a problem  
 - form of characters is not just affected by passage of generations + mutation....

**Darwin's Big Idea #2  
 NATURAL SELECTION**

...what this means....

An organism's appearance is a combination:

- B.I. #1) **passively derived characters**
  - Community of Descent
- B.I. #2) **selectively "forced" characters**
  - Adaptation by N. S.

(all chars. are **inherited**, but note terminology)

Through adaptation to **similar conditions**, organisms can acquire **similar characters** despite distinct, distant, ancestries

**EVOLUTIONARY  
 CONVERGENCE**

Resemblances due to:  
**Descent = homologous characters**  
**Adaptation = analogous characters**

If our classification is to be **natural**, reflecting **only** descent, we must **ignore** analogous chars. (whales & fish etc.....)

**distinction is often tricky**  
*analogues not necessarily superficial*

**HOMOLOGUES** -same basic structure

**ANALOGUES**

-superficial (functional) similarity

Function	flight	swimming
Organ	wing	fin
Tetrapod	bat, bird	dolphin, seal
Analogue	butterfly	fish fin

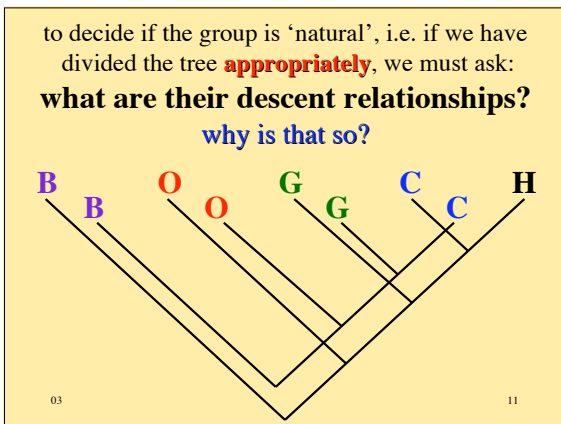
Function	grasping	leaping
Organ	claw	limb
Tetrapod	cat	kangaroo
Analogue	mantis	grasshopper

-if we make groups based on analogues, we make **unnatural groups** - ones where members are **not** each others' closest relatives.

-so we see that nature is **patterned** in a **hierarchy of structural similarity** -and that this is there because of **evolutionary descent** -**but** we see a difficulty in finding the **true** structure because of **convergence** -our task in making Natural Classifications is to ensure that **all** members of a group are indeed **each other's closest relatives**

-another way to say this is:  
**Our classification must map directly onto Life's Evolutionary Tree**  
 -the job of making a **Natural Classification** resolves to:  
 1. Constructing a "true" tree **only descent**  
 2. Dividing that tree **appropriately**  
 -we now turn to dividing that tree....

are **'Great Apes' (Pongidae)** a **natural group?**  
 gibbons, orang utan, gorilla, chimpanzee



so if chimps...gibbons are "apes", so are we "Great Apes", a Family excluding humans, is **NOT** a Natural Group

Barbets - pan-tropical  
 South American toucans

non-natural groups can also arise if we are fooled by convergent similarity  
 New World "vultures" resemble Old World "true" vultures because of **adaptive convergence**



non-natural groups include members who have closer **relatives outside** the group

## TERMINOLOGY

a group of species including the ancestor and **ALL** descendant species

**MONOPHYLETIC GROUP**  
*this is our goal in modern classification*

Plantae, Chordata, Mammalia

a group with the ancestor but only **SOME** of the descendants, excluding others

**PARAPHYLETIC GROUP**  
 "Great Apes", "Barbets", "Invertebrates", "Reptiles"\*

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-finally:

## POLYPHYLETIC GROUP

group containing species derived from 2 or more **unrelated** lineages

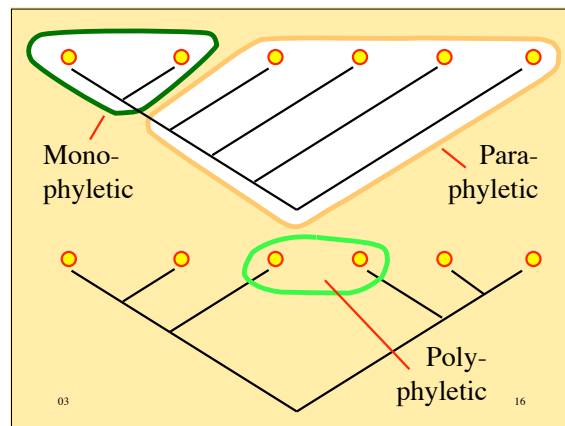
*-due to mistakes from convergence*  
 "vultures"; "Plants" vs. "Animals"

-so goal of modern classification is to describe & name **monophyletic groups**

-such groups **map directly onto the tree**

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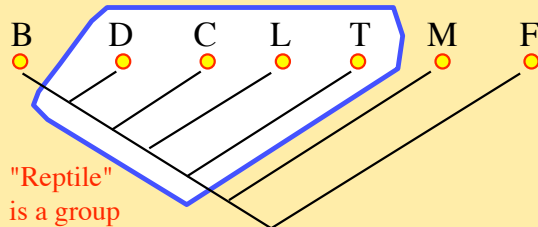
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We are used to birds, mammals & reptiles\* as natural groups; **but what is their genealogy?**



"Reptile" is a group based in surface characteristics

-not in ancestry patterns

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## PHYLOGENY

-our best effort so far at inferring descent relationships

*-difficulties presented by convergence*

## CLASSIFICATION

-representation of phylogeny in named groups

*-thus classifications change as our knowledge of phylogeny advances*

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**- are the Five Kingdoms  
Natural Groups?**

Next class:  
The Prokaryotes

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