

Evolution

Definition evolution:

- Gradual/cumulative change characteristics of organism generation to generation over prolonged period of time

History Evolution Theory:

- Theory: explanation observed things supported scientifically collected data/modified more evidence available
- Jean Baptise Lamarck
 - Argued life not fixed
 - Environments changed, organisms change behaviour to survive
 - Use and disuse: if used organ increase in size
 - Discredited as phenotypes not passed to offspring and redundant organs (ie: tonsils) not disappear
- Alfred Russel Wallace
 - Independently conceived of nature, even observable , way for life to change
- Charles Darwin
 - Published origin of species on natural selection
 - HMS Beagle
 - Galapagos Islands (rough terrain see changes easily)
- Observed:
 - Offspring same species produce large number of offspring
 - Only few survive
 - Survival organism depend on natural selection
- If organism have trait help withstand elements/breed more successfully=produce more offspring so trait become more common
- Darwin said variation occur, adaptations favour survival passed on, population produce more offspring than environment can support=survival fittest

VISTA

Variation and Inheritance:

- Sexual reproduction result in variation
- Some variations more favourable allowing individual to survive
- Variation result random mutations cell divide (ie: size, colouration)

Selection:

- Environment not support unlimited growth
- Organisms experience environmental pressures (competition, predation, climatic, disease)
- Some individuals more successful finding food, mating, avoiding predation=survive/breed=pass on DNA (differential reproduction)

Evolution

Time and Adaption:

- Advantageous trait passed onto next generation=common population
IE: Giraffe
Variation physical make up result small changes
Compete same resources
Longer neck favour survival
Longer neck reproduce
Overtime variation in species increases
Until new species

Adaptive radiation:

- Process species evolve rapidly to exploit empty niches
- Ecological niches exert selection pressures that push population to evolve various directions
 - Finches
 - Several species adapt different environmental niches
 - Different beak shape for different food source
 - Evolve from ground dwelling to seed eating finches

IE: English Peppered Moth

Well camouflaged on speckled lichen tree trunk

Genetic mutation cause black moth to appear

Pollution cause lichen die off so black moth favoured survival

Pollution improved white moth favoured survival

All about **reproductive advantage** and **mutation**

Evidence for Evolution:

Fossils

- Age of earth 4.56 billion years old
- Calculated oldest terrestrial minerals (crystal zircon Australia)
- Age solar system (lunar samples)
- Methods dating rocks
 - Radio metric (half life decay radioactive elements)
 - Stratigraphy
 - Carbon 14 dating (organic compounds contain carbon-change over time)
 - Molecular clocks (genetic material)
- Show similarities organism living today
- Organism develop overtime
- Morphological divergence (change structurally to ancestor)
- Differences different environment

Evolution

Note:

- Precambrian: origin life
- Palaeozoic: Ancient Life (plant, in/ vertebrates)
- Mesozoic: Age Reptiles (Flowering plants/dinosaurs)
- Coenozoic: Age of mammals (diversification flowering plants, insects, birds, mammals)
- Palaeontologist: study fossils
- Anthropologist: study social network/development societies
- Archaeologists: excavate fossils

Comparative Anatomy:

- Homologous structure
 - One that is similar in structure to common ancestor
 - Not necessarily have same function
 - Frogs, rabbits, lizards different forelimbs different lifestyles
 - Divergent evolution (new species)
- Analogous structure
 - Perform same function not evolve similar ancestor
 - Insect wings, bat wings
 - Convergent evolution (species not closely related develop similar trait relieve evolutionary pressure)

Comparative Embryology:

- Vertebrates follow common pattern development=common ancestry
- Similar genes define basic body plan
- Grow embryo distinguished

Comparative Biochemistry

- DNA similarities
- Similar genes
- Similar protein synthesis (amino acid sequence in haemoglobin)
 - Look at number differing nucleotide bases
- Similar metabolic pathways
 - Cellular respiration
 - Identical amino acid Cytochrome C needed cellular respiration (humans, fungi)

Biogeography:

- Isolated groups/islands develop own distinct plant/animal
- Gondwanaland
 - Africa, South America, Australia, New Zealand

Evolution

- Emu, ostrich, rhea
- Different ecological niches (food, predators, climate)

Artificial Selection/Selective Breeding:

- Humans consciously select for/against features of organism
 - Dogs domesticated wolves
 - Brussels/broccoli wild mustard plant
- Used crop production (strongest/biggest seed used)
 - Sweet apples
 - Weed resistant

Neo-Darwinism:

- Evolution take place environment changing slowly
- Exert selection pressure
- Characteristics more likely survive=reproduce
- Overtime genetic makeup changes
- New species

Mechanisms Evolution

- **Natural selection**
 - Organism best adaptations environment survive, reproduce, pass genes offspring
- **Mutation**
 - Neutral
 - Change sequence DNA may/may not change sequence amino acids protein
 - Not change function protein
 - Lethal
 - DNA change amino acid sequence so change function of protein
 - Unfavourable phenotype
 - Fixed
 - DNA sequence change **favourable phenotype**
 - **Better adapted, survive environment, breed**
 - Change in phenotype because of genotype (Discontinuous: single pair allele/continuous: many different genes interacting)
 - **Sexual reproduction:** randomness fertilization, chiasmata, random assortment
- **Migration**
 - **Gene flow:** Movement genes one population to another
- **Genetic drift**
 - Change in frequency of a gene

Microevolution:

- Change in frequency of an allele
- Changes in gene pool of population over time

Evolution

- Slight change genotype over few generations before new species formed
- Change come about because:
 - Mutation
 - Migration/gene flow
 - Random genetic drift from one generation to another
 - Natural selection favour gene

Larger, darker-survive in cold

IE: Microevolution in populations:

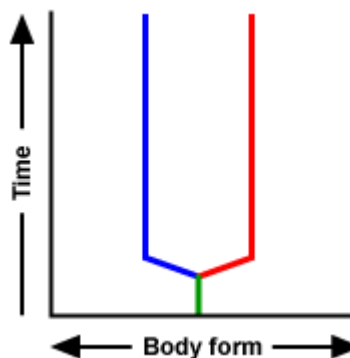
- Mosquitos evolving resistance DDT
- Drug resistant TB
- HIV strains evolving resistance to antiretroviral's

Macroevolution

- Grand scale
- Happen higher than individual level
- Cause new species to arise
- Mechanisms:
 - Mutation
 - Genetic drift
 - Natural selection
- Stasis:
 - Animals evolve slowly
 - Crocodiles
- Morphological change/anagenesis
 - Straight line evolution
 - Lineages change quickly/slowly
 - Morphological change can happen in one direction and reverse its self
- Lineage splitting/cladogenesis (speciation)
 - Divergent evolution
- Evolution
 - Frequent/rare within lineage

1. **Stasis:** Many lineages on the tree of life exhibit stasis, which just means that they don't change much for a long time, as shown in the figure to the right.

In fact, some lineages have changed so little for such a long time that they are often called living fossils. Coelacanth's comprise a fish lineage that branched off of the tree near the base of the vertebrate **clade**. Until



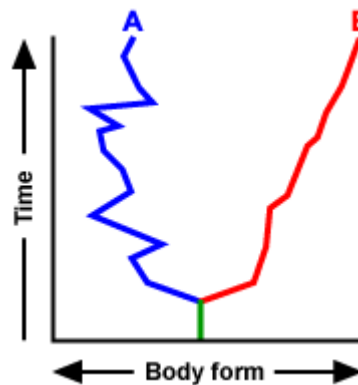
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1938, scientists thought that coelacanths went extinct 80 million years ago. But in 1938, scientists discovered a living coelacanth from a population in the Indian Ocean that looked very similar to its fossil ancestors. Hence, the coelacanth lineage exhibits about 80 million years' worth of morphological stasis.

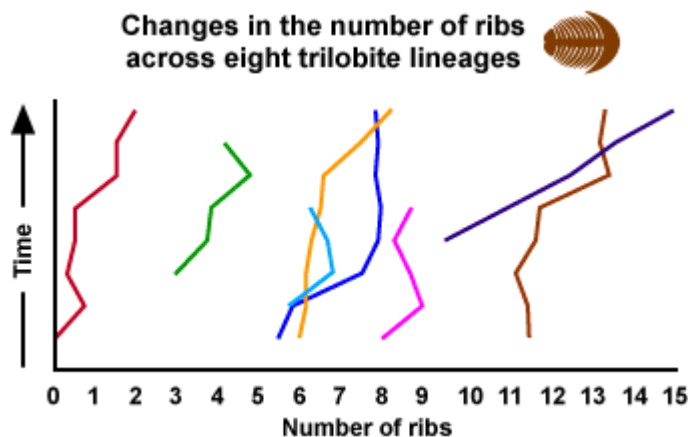


A coelacanth swimming near Sulawesi, Indonesia

2. **Character change:** Lineages can change quickly or slowly. Character change can happen in a single direction, such as evolving additional segments, or it can reverse itself by gaining and then losing segments. Changes can occur within a single lineage or across several lineages. In the figure to the right, lineage A changes rapidly but in no particular direction. Lineage B shows slower, directional change.

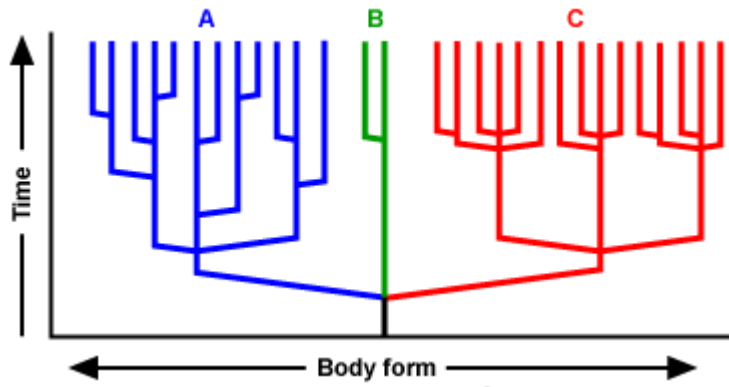


Trilobites, animals in the same clade as modern insects and crustaceans, lived over 300 million years ago. As shown below, their fossil record clearly suggests that several lineages underwent similar increases in segment number over the course of millions of years.



3. **Lineage-splitting (or speciation):** Patterns of lineage-splitting can be identified by constructing and examining a phylogeny. The phylogeny might reveal that a particular lineage has undergone unusually frequent lineage-splitting, generating a "bushy" tuft of branches on the tree (Clade A, below). It might reveal that a lineage has an unusually low rate of lineage-splitting, represented by a long branch with very few twigs coming off (Clade B, below). Or it might reveal that several lineages experienced a burst of lineage-splitting at the same time (Clade C, below).

Evolution



4. **Extinction:** Extinction is extremely important in the history of life. It can be a frequent or rare event within a lineage, or it can occur simultaneously across many lineages (mass extinction). Every lineage has some chance of becoming extinct, and overwhelmingly, species have ended up in the losing slots on this roulette wheel: over 99% of the species that have ever lived on Earth have gone extinct. In this diagram, a mass extinction cuts short the lifetimes of many species, and only three survive.

