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Macroevolution

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Macroevolution

- Definition – large-scale patterns, trends and rates of change among families and more inclusive groups of a species

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Fossils

- Definition – Latin word that means “dug up” – evidence of past life
- remnants of the dead
  - bones
  - scales
  - shells
  - seeds

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Fossils

- Definition – Latin word that means “dug up” – evidence of past life
- remnants of the dead
  - capsules
  - entire organisms frozen or encased in amber
  - coprolites-fossilized feces
  - evidence of previously living organisms
    - footprints
    - leaf prints
    - trails
    - tracks
    - burrows

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Fossils

- fossilization– the creation of fossils
  - volcanic ash
  - volcanic lava
  - sediments in a lake or ocean
  - ice
  - amber

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Fossils

- fossilization– the creation of fossils
  - organic material that makes up the organism is replaced by metals or organic
  - salts to become hard – permanent
  - time and pressure are usually needed
  - usually quite rare
  - must be rapid before decay can take place
  - lack of oxygen – causes oxidation and decay
  - must remain undisturbed for best results

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Fossils

- fossil evidence interpretation
  - upper layers formed last – deeper layers are older
  - sometimes geologic events upend fossil strata and layers must be evaluated with this in mind
  - fossils from the same layer are from the same time period
  - fossils can be used to assign dates to rock layers

8 ## Fossils

- problems with fossil evidence
  - we only have a very slight record of the diversity of organisms from fossils
  - fossilization is rare and favors hard structures organisms or parts of organisms
  - many fossils have been destroyed by geology or people
  - most species were not preserved as fossils especially invertebrates
  - most fossils are from land animals very few from the oceans (3/4 of earth is under water!)
  - most fossils came from northern hemispheres (fossil hunters lived here)

9 ## Continental Drift and Pangea

- Taylor and Wegner first theorized about a possible different configuration of the earth
- the continents were connected in a single massive landmass called Pangea
- most scholars of the day (1908-1930's) dismissed the theory

10 ## Continental Drift and Pangea

- in the 1950's magnetic properties of rocks led to a revival of the theory
- the magnetic poles in these rocks were not aimed at the current pole directions
- this means the poles must have moved!
- when scientists aligned the rotation of these rocks together they re-assembled the two main continents into one single one

11 ## Continental Drift and Pangea

- the biggest problem to the theory was how did the continents move
- seafloor spreading was found and explained the movement of continents
- this also explains
  volcanoes and
  earthquakes
- all of these massive changes in landmass drastically changed the populations of earth

12 ## Continental Drift and Pangea

13 ## Embryology Meets Evolution

- comparison of the developmental patterns of early embryos is called comparative embryology
- early embryos of vertebrates are highly similar, but not as similar to initial drawings by Haeckel – these are shown
  in your book
- we have similar early embryology because we are essentially the same genotype with slight differences that lead to the human form and not frogs or fish

14 ## Homologous, Analogous – Divergence and Convergence

- Analogous structures: Anatomical structures that show similar function, but dissimilar in embryonic and evolutionary background are said to be analogous.
- Convergent evolution has made these structures appear similar.
- Examples of analogous structures are: wing of bat and wing of an insect.

15 ## Homologous, Analogous – Divergence and Convergence

- Homologous structures are related by embryological origin, but may have changed due to divergent evolutionary pressures.
- Examples of homologous organs are: wing of bat, forelimb of horse; flipper of dolphin and the arm of man/woman.

16 ## Homologous, Analogous – Divergence and Convergence

- Convergence – lineages that are not related evolve in similar directions

- Examples: sharks, penguins and porpoises all have evolved fin-like structures to move them rapidly through water

17 **Homologous, Analogous – Divergence and Convergence**

- Divergence – a change in forms from a common ancestor
- examples: forelimbs of birds, man, horses, bats and reptiles

18 ## Molecular Clocks

- neutral mutations in genes that are highly conserved (mostly stay the same in all creatures) can be used to measure evolution
- protein comparisons – gel electrophoresis is used to study the proteins of organism
  - if two species have many highly similar protein sequences – they are closely related
  - amino acid substitution comparison of human cytochrome c (respiratory protein)
    - 56 differences in yeast
    - 19 in turtles
    - 18 in chickens
    - 1 in rhesus monkey
- we are more closely related to the rhesus monkey than the other species

19 ## Molecular Clocks

- Nucleic acid comparisons (DNA or RNA)
  - DNA-DNA hybridization experiments
    - the better they bind (re-anneal) the more closely related
    - if they poorly anneal then they are more distantly related
  - mitochondrial DNA – mDNA
  - found in every cell shows heredity well
    - passed down through maternal side only
    - all cytoplasm is contributed by mother in all cases
    - very clear relations can be determined