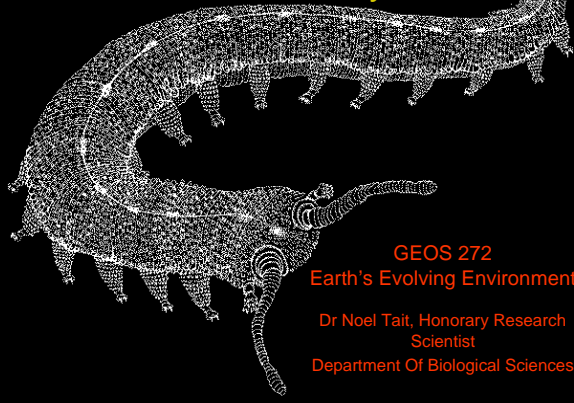


Evolution and Diversity of Animals



GEOS 272
Earth's Evolving Environment

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Animal body plans

- A body plan is a basic pattern of anatomical organisation shared by a group of organisms
- At the highest level of classification of animals, this is referred to as a phylum
- There are 32 animal phyla each with a distinctive body plan
- Many of these phyla have a significant fossil record, and amazingly, nearly all appeared together in an apparent "explosion" of evolution at the beginning of the Cambrian
- This event is termed the 'Cambrian explosion'

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The 32 animal phyla listed in evolutionary relationship

| | | |
|------------------------|-------------------|-----------------------------|
| Placozoa | Acathocephala | Echiura |
| Porifera | Nematoda | Annelida |
| Cnidaria | Nematomorpha | Phoronida |
| Ctenophora | Kinorhyncha | Bryozoa (Ectoprocta) |
| Platyhelminthes | Loricifera | Cycliophora |
| Mesozoa | Priapulida | Brachiopoda |
| Nemertea | Onychophora | Echinodermata |
| Gnathostomulida | Tardigradia | Hemichordata |
| Ectoprocta | Arthropoda | Chaetognatha |
| Rotifera | Mollusca | Chordata |
| Gastrotricha | Sipuncula | •Urochordata |
| | | •Cephalochordata |
| | | •Vertebrata |

Large number of species

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Largest phyla showing number of species

| | | | |
|------------------------|---------|-----------------------------|--------|
| Arthropoda | 900,000 | Annelida | 12,000 |
| Mollusca | 50,000 | Cnidaria | 8,900 |
| Chordata | 41,275 | Echinodermata | 6,000 |
| (Vertebrata 40,000) | | Porifera | 5,000 |
| Platyhelminthes | 18,500 | Bryozoa (Ectoprocta) | 5,000 |
| Nematoda | 12,000 | | |

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Animal phyla with terrestrial species

| | | |
|------------------------|--------------------|----------------------|
| Placozoa | Acathocephala | Echiura |
| Porifera | Nematoda | Annelida |
| Cnidaria | Nematomorpha | Phoronida |
| Ctenophora | Kinorhyncha | Bryozoa (Ectoprocta) |
| Platyhelminthes | Loricifera | Cycliophora |
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| Rotifera | Mollusca | Chordata |
| Gastrotricha | Sipuncula | •Urochordata |
| | | •Cephalochordata |
| | | •Vertebrata |

containing terrestrial species

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Changes to phyla over time

- Recent discoveries
 - Gnathostomulida 1956, Loricifera 1983, Cycliophora 1995
- Recent deletion
 - Pogonophora discovered 1914 moved to Annelida 2005
- Recent separations
 - Coelenterata now Cnidaria and Ctenophora, Bryozoa now Endoprocta and Bryozoa (Ectoprocta)
- Extinctions of whole phyla over geologic time
 - Archaeocyatha, Scolectodonta, Conodonta, Chilinozoa, Graptolita
- Extinction of major groups within phyla over geologic time
 - Rugosa and Tabulata (Cnidaria), Trilobita (Arthropoda), Ammonoidea (Mollusca), Carpoidea and Blastoidea (Echinodermata)
- Phyla as remnants of past dominance
 - Brachiopoda, Bryozoa

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Phylogeny - the history of life on Earth

Evidence used for phylogenetic reconstruction

Fossil record, the ultimate source of information about evolutionary change over time

Comparative anatomy, analysis of similarities and differences among groups of organisms

Embryology, some animal groups are more similar to each other as juveniles than adults

Molecular, differences and similarities in the structure of a particular organic molecule among groups of organisms, such as the amino acid sequence of a particular protein or the nucleotide sequence of a particular gene

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Evidence used for phylogenetic reconstruction

Fossil record, the ultimate source of information about evolutionary change over time

- Some environments are more conducive to forming fossils than others
- Usually only hard parts (skeletons) are fossilised
- Fossils have to be found
- Loss of fossils due to alteration in rocks containing fossils

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Evidence used for phylogenetic reconstruction

Comparative anatomy, analysis of similarities and differences among groups of organisms

- Problems of convergence, groups of organisms linked together because they look similar but do not have a common ancestor (polyphyletic)
- Identification of monophyletic lineages in which all members share a common ancestor

Embryology, some animal groups are more similar to each other as juveniles than they are as adults

- Changes may occur at early stages of development leading to the emergence of novel evolutionary lineages

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Phylogeny - the history of life on Earth

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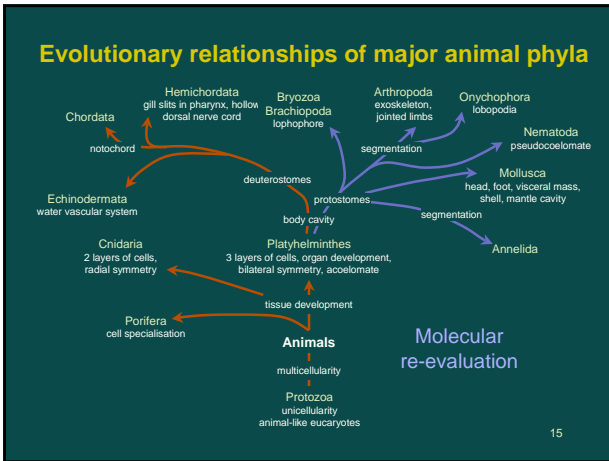
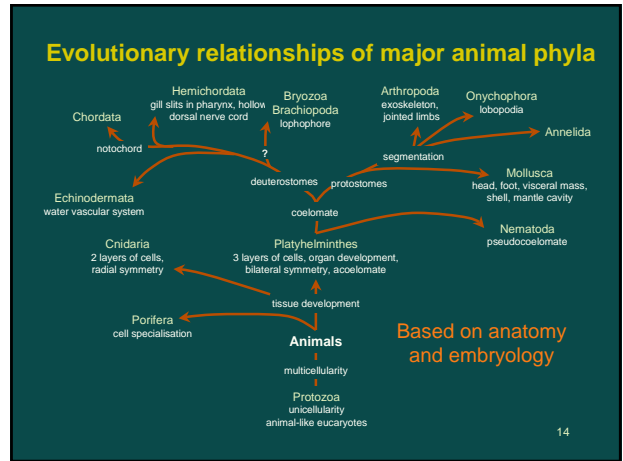
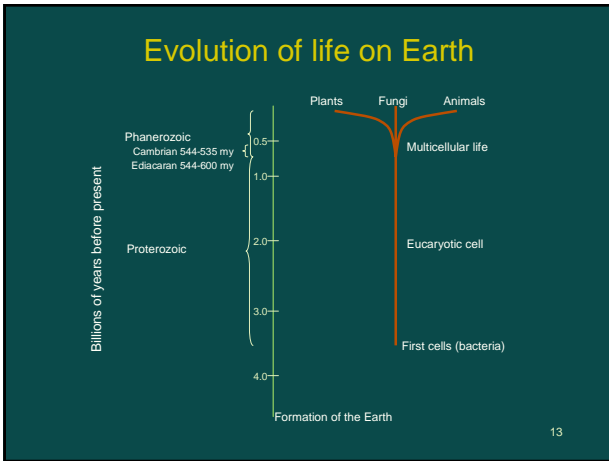
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Evidence used for phylogenetic reconstruction

Molecular, differences and similarities in the structure of an organic molecule among groups of organisms, such as the amino acid sequence of a particular protein or the nucleotide sequence of a gene

- Molecular evidence provides an independent data set to that obtained from comparative anatomy and embryology
- Requires a number of molecules to be analysed

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Porifera – sponges

Loose association of cells supported by skeleton of spicules, fibres or both

A

B

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Cnidaria – corals, sea anemones, jellyfish

Radial symmetry, 2 tissue layers, 1 opening to gut

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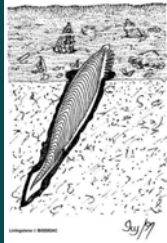
Cnidaria – coral reefs and blue bottles

Colony formation – reefs

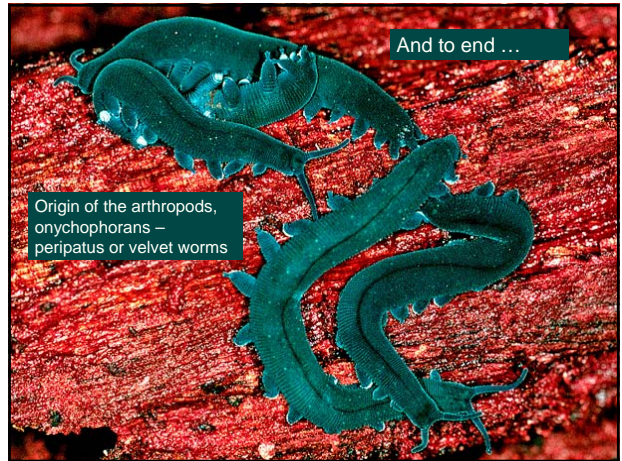
Polymorphism – specialised individuals

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Chordata – sea squirts, lancelets, vertebrates



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And to end ...

Origin of the arthropods,
onychophorans –
peripatus or velvet worms