

Animal Origins

animals were probably the first kingdom of truly multicellular organisms to appear on earth

animals did not evolve suddenly
→ lots of experimentation

eg. Bacteria and protists set the stage for animals:

1. **locomotion:** flagella, cilia, amoeboid motion, gliding
2. **complex life cycles:** alt of generations
3. **resistant cysts**
4. **skeletons and shells:** support
5. **gender behaviors**
6. **cell-to-cell communication:** chemical messengers leading to hormones and neurotransmitters
7. **lethal toxins for defense:** venoms, poisons, etc
8. some bacteria manufacture **hemoglobin** to store O₂
9. introduced DNA recombination, genders & sex, meiosis and programmed cell death

main difference is that cells of animals clump together, specialize and become dependent upon each other

this does not occur in unicellular bacteria and protists
at best they are colonial (a very loose association)

earliest evidence of animal life are found over 1 billion years ago → but not true fossils

= **trace fossils** (burrows, etc)

many soft bodied impressions are found in some rocks

but sometimes difficult to distinguish between protists and animals

Cambrian Explosion

most living animal phyla can be traced back to
Cambrian (570 MY)

only 3 of the major animal phyla have a fossil record
before the Cambrian

eg. 700MY Ediacaran fossils

their size and lack of armor indicate that
large predators had not yet evolved

fossils of all major animal phyla are found after this event

→ virtually all major animal groups (phyla) appeared in a geologic instant (~10 M yrs)

→ no major new animal body plans have arisen since then

from 1BY to 750 MY ago there was a supercontinent = **Rodinia**

as it started to break up it caused global cooling
destroyed diverse shallow water ecosystems
reduced CO₂ generation
→ snowball earth = entire ocean froze over

just before Cambrian it began to thaw
thawed very quickly

→ possibly in less than 1000 years
may have lead to explosion of diversity

a. some suggest that a threshold level of O₂ induced animal evolution

b. warm shallow seas may have promoted diversification

much of North America was covered by a warm shallow sea rich in nutrients, rising oxygen levels

c. evolution of hard teeth and skeletons

hard bodied invertebrates (animals) are much more likely to leave fossils

only after animals began trying to eat each other

→ evolved larger sizes, harder coverings

shells may have been a way to recycle abundant calcium in sea water

in marine cells the $[Ca^{++}]$ is 10,000 x's less than in sea water

small amounts of Ca^{++} are needed for signaling

too much is toxic

when too much Ca^{++} enters a cell it precipitates as calcium phosphate

→ deprives cells of essential phosphorus

→ fatal precipitate: eg. kidney stones

Ca^{++} excess must be shunted outside of the body

animals began to use this excess toxin for defense, support, teeth, spines

→ transformed a pollutant into something useful

[Nabokov – the greatest enhancements in nature involve deception]

by the middle of the Cambrian age virtually every major invertebrate group was well represented

Arthropods have dominated the fossil record since the Cambrian

one of the oldest animal species on earth (has remained unchanged) is *Triops cancriformis*

→ 180 M yrs → requires no males

insects - have dominated earth since carboniferous (300 MY)

vs **angiosperms** - dominated land plants last 150 MY
only 18% of all species