Rhodophyta (red algae)

- multicellular
- red pigment (phycoerythrin)
- photosynthetic
- absorb blue/green light that penetrated deep water
- can be found down to 260m deep
- complex life cycles
- alternations of generations

Chlorophyta (green Algae)

- considered to be the closest ancestors of truw plants
- over 7000 species
- some colonial (volvox) with 1000 of flagellated cells
- some multicellular (ulva, sea lettuce)
- some live symbiotically with fungi to form lichens
- close relatives of land plants

What is a plant?

- Land plants form a monophyletic clade, Decend from a single common ancestor

Clade → a group of organisms believed to comprise all the evolutionary desendants of a common ancestor

LAND PLANTS

How are they different from algae?

- First vascular plants were successful on land because of the cuticle, positive layers for the gametangia and the absence of herbivores
- Fossils from the saurian age (443.4 +/- 1.5 million years ago)

Rhyniophytes (Silurian)

- Earliest vascular plants, now extinct
- Had dichotomous branching but lacked leaves and roots
- Anchored by ribosomes (horizontal portions of stem) and rhizoids (water absorbing filaments)

Land plants History

- First appeared on land between 400/500 million years ago
- Adaptations were needed to survive in a dry environment
- Large plants also needed support and methods to disperse gametes, including ways to transport water to all parts of the plant

Characteristics of land plants

- Cuticle
- Stomata
- Gametangia enclosing gametes
- Embryos in protective structure
- Pigments that protect against UV radiation
- Mutualistic relationships with fungus
- Spore walls containing sporopollerin
    - ➢ Tough outer walls of plant spores/pollen grains

Soil

- Ancient plants contributed to soil formation
- Acids secreted by plants help break down rocks
- Organic material from dead plants, dead organic matter (DOM) contribute to soil structure

Present day non-vascular plants

- Thought to be similar to the first land plants
- Grow in moist environments in dense mats
- Small with no system to conduct water from soil to plant parts
- Growth pattern allow water to move through mats by capillary action and minerals can be distributed through the small plants by diffusion

ORIGIN OF MULTICELLULAR ORGANISMS

Eukaryotes

- Complex cells
- Nucleus
- Organelles, membrane bound
- Complex cytoskeleton

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Protists → single celled eukaryotes

- Don't form a single clade/monophyletic group
- There are many different groups of protists

Groups of Protists

Aveolata

- very diverse group
- characterised by the presence of small membrane bound cavities, Cortical Alveoli, under the plasma membrane
- include some important/significant taxa
    - Dinoflagellates, Ciliates, Apiocomplexans

Dinoflagellates

- >2000 species
- Have a flagellum
- Many are photosynthetic and consume other organisms
- Autotrophic and heterotrophic
- Most reproduce asexually
- Marine and freshwater
- Some are bioluminescent
    - Probable defence mechanism to startle/ward off predators
- Can cause red tides due to an excess of nutrients in the water lead to very rapid reproduction (a bloom) and may lead to a build-up of toxins

Ciliates

- Highly diverse group
- +30,000 species
- Characterised by presence of multiple cilia
    - High amount of hair-lke organelles similar to flagella but shorter
- Mainly fresh water
- Most free-living
    - Some symbiotic and parasitic species known
- Asexual reproduction and exchange of DNA between individuals

Apicomplexans

- Intra-cellular parasites
- No flagella
- Specialised organelle called an apical complex
    - Used to penetrate host cells
- Have a relict plastid called an apicoplast
- Complex life cycle with sexual and asexual reproductions
- Include several medically important parasites including:
    - Plasmodium (causes malaria)
    - Taxoplasma (causes taxoplasmosis)

Malaria

- Caused by plasmodium
    - A protozoan parasite transmitted by female anopheles mosquito
- 300 – 500 million cases per years
- Annually 1 – 2 million mortalities

Biggest tapeworm

- Is Polygoroporus giganticus
- >30m long
- Infects whales

Phylum Rotifers

- Rotifera's
- Tiny (<2mm)
- A few hundred cells
- Use cilia to move and feed
- Simple gut
- Two light sensitive spots
- Some species all female → reproduce by Parthenogenesis

PHYLUM ANNELIDA

Class Oligocheta

- Earth worm
- Segmented worms
- Linear gut with oesophagus, crop, gizzard, intestine
- Coelom partitioned by septa
- Blood vessels with haemoglobin (circulation)
- Cerebral ganglia
- Excretory tubes (metnephridia)
- Longitudinal and circular muscles

Class Polychaeta

- Polychaetes
- Most are marine
- Bristles extend from paired, fleshy parapods on each segment
- Head end is specialised

Class Hirudinea

- Leeches
- Flattened body with reduced coelom and appendages
- Has suckers at anterior and posterior end
- Predator and parasite

SKIN SHEDDERS
Introduction to Ecdysozoa

Protostomia/Protostomes to major groupings
- Lophotrochozoa (or Spiralia)
- Ecdysozoa

Name comes from:
- Ecdysis = moulting from the cuticle
- Zoa = animals

} "Moulting animals"

Ecdysozoa characterised by:
- Moulted cuticle
  - Cuticle → outer, non-cellular layer of the integument secreted by epidermis
  - Moulting (ecdysis) → old cuticle shed and replaced by new, larger cuticle
    - → Allows the animal to grow

Ecdysozoa Phyla
Based on current evidence, 8 phyla are members of ecdysozoa
- 5 worm-like phyla (Lack Paired appendages)
  1. Priapulida
  2. Loricifera
  3. Kinorhyncha
  4. Nematoda
  5. Nematomorpha
- 3 arthropod-like phyl
  1. Tardigrada
  2. Onychophora
  3. Arthropoda
     - Have paired ventrolateral (down and to the side) appendages = 'limbs'
     - These have completely independent evolutionary origin from limbs or vertebrates

Worm-like ecdysozoans
- Phylum Priapulida or priapulids
- Pirapulid worms or penis worms or cactus worms
- Marine, most species appear to be carnivorous
- True coelom probably present
- Straight gut with anterior mouth and posterior anus
- ~20 living species
- 0.5mm to 20cm
- Fossil record stretches back to Cambrian

Phylum Loricifera – 'worm like'
- Loriciferans or 'brush heads'
- Enigmatic phylum only discovered in 1983
- 0.1 – 1mm in size
- Straight gut with mouth and anus
- Live in sediment
  - Diet is uncertain, as are many other basic aspects of their biology
- ~30 species described, many more undescribed

Phylum Kinorhyncha – 'worm like'
- Kinorhynchans or 'mud dragons' or 'spiny-crown worms'
- 0.1 – 1mm long
- Pseudocoelom
- Segmented, lack limbs
- Straight gut with mouth and anus
- Live in sediment
- ~180 described species (very little known about them)

ARTHROPOD DIVERSITY

General features

- Segmented bodies
- Segments often modified
- Separate mouth and nus
- External hard covering
    - With protiens, chitin (cuticular exoskeleton)
- Jointed appendages
    - Paired legs, antennae, mouthparts
- Tracheal Respiration and/or gills in larger aquatic stages or book lungs
- Metamorphosis – may occur in advanced forms
- Ventral nerve cord (runs underneath body)
- Sensory organs and complex behaviour

Ecdysis (moulting)

- Shedding of the cuticle allows growth
- Neurosecretory cells produc hormone ecdysone
- Increase in epidermal cell activity, protein and RNA and glycogen reserves
- Premoult, moult, post-moult, intermoult
- Old cuticle separates from epidermis, partially digested, new cuticle laid down
- Body inflates, old cuticle shed

Individuals

- ~1.5 million species described
- Marine
- Freshwater
- Terrestrial
- ~1018 moles ($6.0x10^{23}$)
- Burgess shale
    - Arthropod community (520 million years ago)

Cambrian 'Explosion'

- 535 – 510 million years ago
- Approx. 80% of basic phyla types occur in fossil record
- Diversity of body plans
- Arthropods, Priapulids, early Chordates, Brachiopods, Cnidarians
- Shallow seas rich in mineral and P, Ca, biomineralization for hard parts, HOX gene selection, predation as a lifestyle

Extinct Groups

- Sea scorpions
- Trilobites

Sea Spiders

- 1300 species
- Size 1mm – 90cm (deep water species)
- Could be an ancient sister group to all other living arthropods

Horse shoe crabs

- Blue blood can be used for medicine
- Primitive 'immune' system
- Injectable vaccines, drugs etc. are free from bacterial contamination use the blue blood from these crabs