Eukaryotic Algae

I. General Characteristics
II. Reproduction and Life History Patterns
III. Photosynthetic Pigments
IV. Chloroplast types
V. Major Polysaccharide Reserves
VI. Flagellated stages and Flagella types

Characteristics Of Eukaryotic Algae
- true nucleus
- well developed organelles
  - mitochondria
  - chloroplasts - surrounded by 2 or 3+ membranes
- more complex reproductive cycles
  - asexual reproductive spores
  - sexual reproduction

Reproduction

Asexual
1. mitosis (cell division)
2. zoospores (flagellated)
3. Fragmentation (filaments)

Sexual Reproduction

Two steps in sexual reproduction:
1. meiosis (reduction division)
2. syngamy (fusion of sex cells)

Zygote - diploid cell resulting from gamete fusion

Three Basic Life History patterns:
- differ in when and where meiosis occurs

Haplontic (zygote)
Diplontic (2n thallus)
Diplohaplontic (sporophyte)

Sexual (production of gametes)
Gametes - types:
- isogamous (gametes identical, flagellated)
- anisogamous (gametes differ in size, flagellated)
- oogamous (flagellated sperm and non-flagellated egg)

Haplontic life History
- vegetative phase is haploid (thallus)
- zygote only diploid cell
- meiosis occurs in zygote (zygotic meiosis)
Hydrodictyon reticulatum

Chara excelsa

Volvox aureus

Spirogyra

Diplontic Life History

- vegetative phase in diploid (2n)
- meiosis occurs in diploid thallus (gametic meiosis)
- gametes are only haploid stage

Fucus gardneri

Diplohaplontic Life History

- meiosis in (2n) thallus sporophyte (sporic meiosis)
- gametes produced by mitosis
- zoospores grow into (n) thallus (gametophyte)

Alternation of Generations

Ulva fenestra

Antithamnion occidentale

Some General Distinguishing Features

photosynthetic pigments
Chl a - all have
Chl b – Green, some Cyanobacteria
Chl c₁, c₂, c₃ - found in Brown Algae (Ochrophyta), Dinophyta, Cryptophyta & Haptophyta
carotenoids - excess energy dissipation? Xanthophyll cycle
Carotenoids cont.

ca. 60 different carotenoids

major carotenoids:

• β-carotene – major yellow pigment in ochrophytes
• fucoxanthin e.g. Browns
• peridinin e.g. Dinoflagellates
• siphonaxanthin e.g. Greens
  (light absorption in deep water?)

More photosynthetic pigments

phycobilins (Phycobiliprotiens)
Cyanobacteria and Red Algae (Rhodophyta)

• phycobiliproteins are a phycobilin (pigment) and associated protein
• water soluble
• organized in phycobilisomes
4 types of Phycobiliproteins:

1. Phycoerythrin (green)
2. Phycoerythrocyanin
3. Phycocyanin (red)
4. Allophycocyanin (650-660 nm)

Energy Transfer Sequence:

Chl a → phycoerythrin (545-575 nm) → phycocyanin (555-636 nm) → allophycocyanin

Model of a Phycobilisome:

- phycoerythrin
- phycocyanin (Chl a)
- allophycocyanin (650-660 nm)
- thylakoid

chloroplast structure:

- number: varies (one in Chlamydomonas to many)
- shape:
  - disk shaped (most)
  - star shaped (Zygnema)
  - spiral (Spirogyra)
  - reticulate (Microspora)
- position:
  - parietal
  - axial
  - central

chloroplast origin:

1° endosymbiont
2° endosymbiont

Polysaccharide Reserves:

- polysaccharide reserves: glucose chains (Glucans), side branching varies between groups and species
- two basic groups
- α-1,4 linked glucose
- β-1,3 linked glucose
Some Storage Products

- Starch
- Cyanophyta starch (glycogen)
- Floridean starch
- paramylon
- chrysolaminaran
- lipids

flagella

9+2 organization (eukaryotic, however no prokaryotic algae are flagellated)
no flagellated cells in the Rhodophyta
- number of flagella
- position (anterior, posterior, transverse)

Flagellar Appendages
- smooth (fine hairs) “whiplash”
- tinsel (stiff hairs - mastigonemes)

Flagellated Cell Types
- isokontous – flagella identical in shape and structure
- heterokontous - (two unequal length flagella usually one smooth one tinsel)