

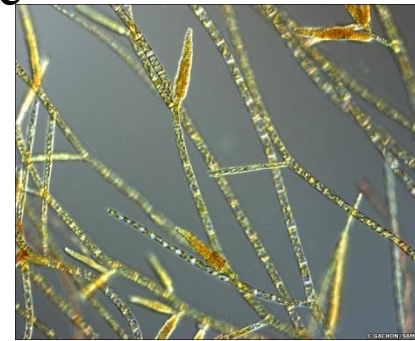


LIFE HISTORY OF *Ectocarpus*

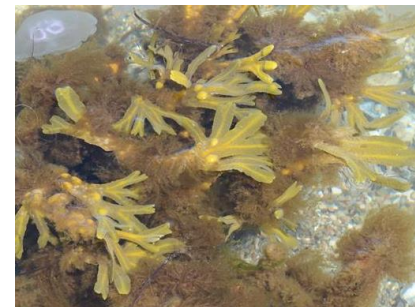
Dr. Urmi Roy

Occurrence

- ***Ekos***: external and ***kapos***: fruit
- Most primitive of all the members of the class Phaeophyceae
- 16 species are found in India.
- Marine habitat
 - Free-floating:
 - *E. spongiosus* and
 - *E. conigerare*,
 - Epiphytes (on other sea plants): on *Laminaria* and *Fucus*
 - *E. breviarticulatus* and
 - *E. coniferus*
 - Endophytic:
 - *E. dermonematis*
 - Epizoic species:
 - *E. fasciculatus* grows on the fins of fishes.
- They are commonly available in both tropical and temperate seas.
- In India they are commonly found in the western coast.



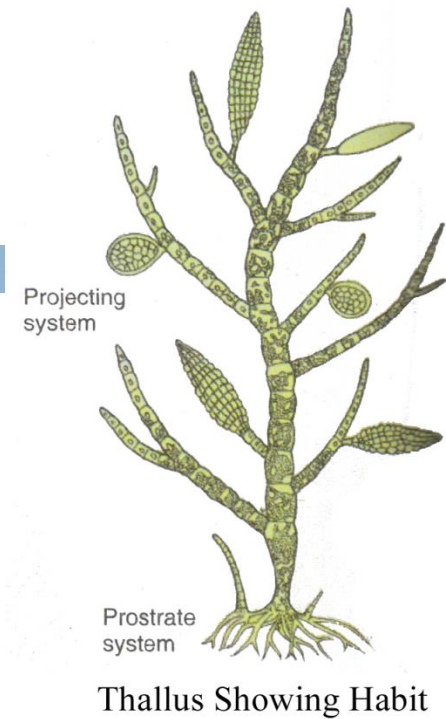
Free floating



Epiphytic on *Fucus*

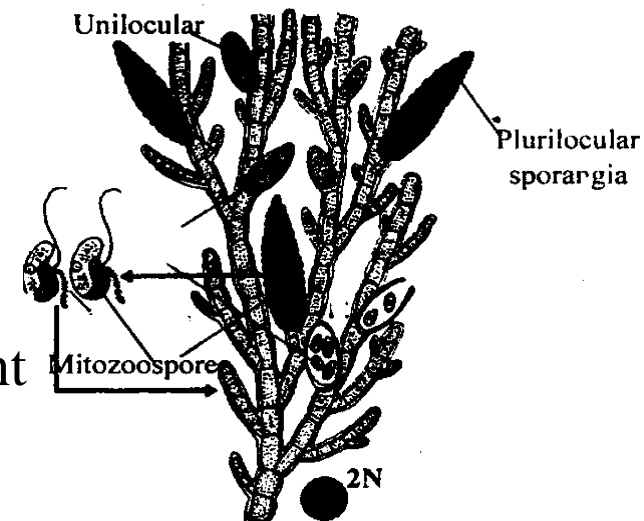
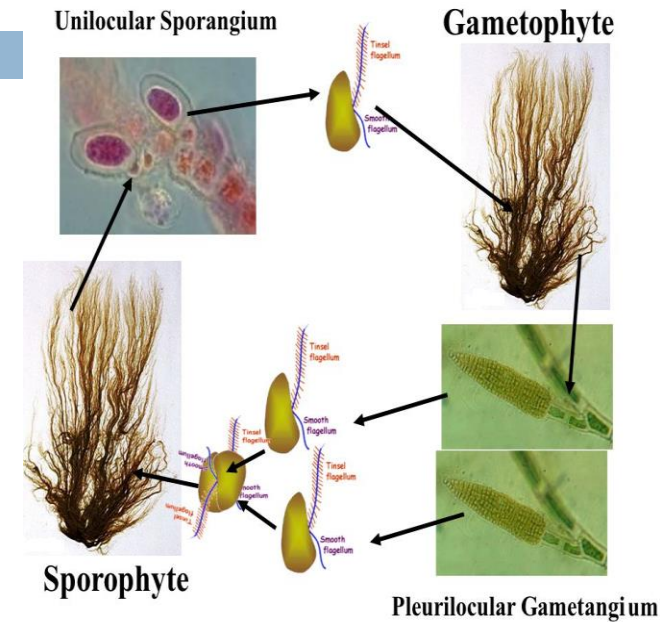
Plant Body

- Heterotrichous: two different parts:
 - The prostrate creeping system
 - It functions as a holdfast,
 - Rhizoid-like
 - Penetrate the substrate
 - Consists of septate, irregularly branched filaments.
 - This system penetrates the host tissues in epiphytic conditions.
 - Poorly developed: in free floating species.
 - Some develop multicellular hairs from the prostrate system (*E. filifer* etc).
 - The erect filamentous, bulbous, or foliose stage.
 - Develops from the prostrate system
 - This remains free-floating.
 - It is much **branched** and well-developed.
 - Both the main axis and branches are **uniseriate** (monosiphonous),
 - But the lower part may become multiseriate (polysiphonous) e.g., *E. geminifructus*.



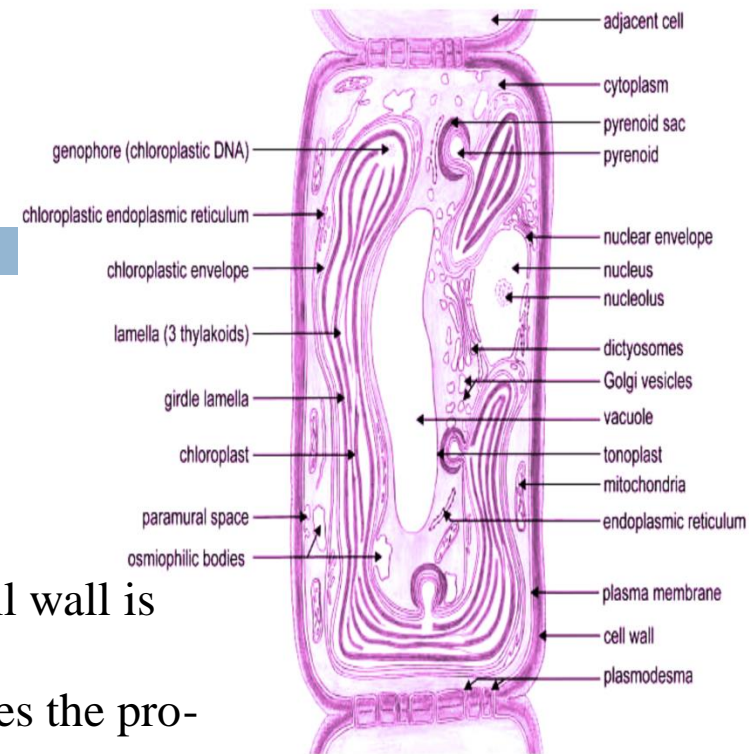
Plant Body.....

- Two types of plant bodies are differentiated genetically
 - ▣ One is haploid and
 - ▣ Other one is diploid.
- Similarity
 - ▣ Both haploid and diploid plants are **morphologically identical**
 - ▣ The haploid and diploid phases are both **filamentous**.
- Dissimilarity
 - ▣ The **diploid** filaments have **longer cells** than the haploid filaments.
 - ▣ The **diploid** plants produce **unilocular** and **plurilocular sporangia** either on the same plant or on separate plants.



Cell Structure

- The cells are rectangular.
- Cell wall is differentiated into
 - Outer pectic and
 - Inner cellulosic layers.
- The cell wall is thick, mucilaginous.
- The characteristic **gelatinous** substance present in the cell wall is composed of **algin** and **fucoidin**.
- Inner to the wall, cell membrane is present which encircles the protoplast.
- The **protoplast** contains one central **nucleus**.
- Ribbon-like or band-shaped chloroplast (chromatophores) with pyrenoid.
- The number and shape of chromatophore varies with species.
- The **pyrenoid** is stalked, pear-shaped.
- The cytoplasm contains many **vacuoles** called as **physodes**, which contain polyphenols, functioning as lysosomes.
- The cells of **haploid** filaments are comparatively **shorter** in length than diploid filaments.



Photosynthetic pigment

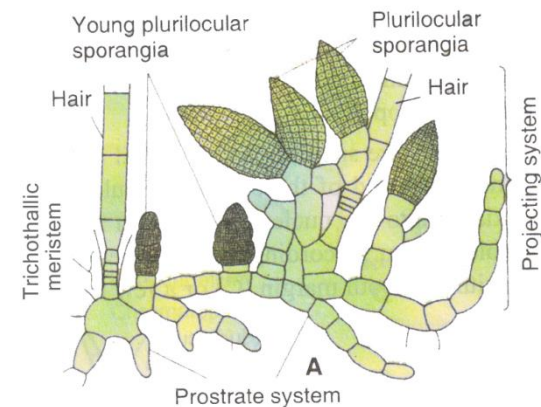
- Pigments are chlorophyll a, chlorophyll c,
- β -carotene and **fucoxanthin**.
- The fucoxanthin masks the chlorophyll.
- This gives the characteristic **brown** colouration.
- Pyrenoid-like bodies-are associated with the chromatophores.
- All other eukaryotic organelles are present.

Cytoplasm

- The cytoplasm contains many vacuoles, which are called *physodes*.
- The physodes contain polyphenols, probably function as lysosomes.
- Morphologically, haploid and diploid vegetative filaments are
 - ▣ Almost alike, but
 - ▣ The cells of haploid filaments are comparatively shorter in length than the diploid filaments.

Growth

- In projecting system :
 - ▣ It is intercalary (apical growth: *Chara*)
 - ▣ It is confined to certain areas of the filaments *i.e.* to the base of one or several filaments: ***trichothallic meristem***.
 - ▣ It increases the length of the terminal hair and vegetative cell of the branch.
 - ▣ This growth is called trichothallic growth.
- Prostrate system: It is apical



Habit showing prostrate and erect system.

Reproduction

- *Ectocarpus* reproduces by both asexual and sexual methods.
- The diploid plants produce unilocular and plurilocular sporangia either on the same plant or on separate plants.

- ***Asexual reproduction:***

- The diploid plants produce: either on the same plant or on separate plants.

- Unilocular and
- Plurilocular sporangia

- ***The plurilocular sporangium:***

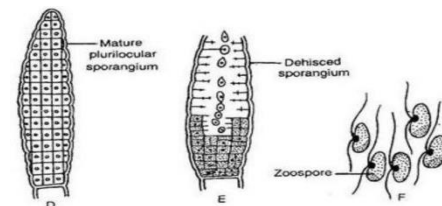
- Divided into cubical cells (as many as 660)
- Each containing a motile cell.
- The plurilocular sporangia (diploid filaments) produce zoospores
- Zoospores settle down and germinate to produce diploid filaments like the parent.



Plurilocular sporangium



Plurilocular sporangia



Reproduction: Asexual...

□ Unilocular sporangia:

- A unilocular sporangium develops from a terminal cell of a short lateral branch.
- The nuclei divide *meiotically*.
- Meiozoospore is pyriform and biflagellate.
- The flagella are **laterally** inserted and are of **unequal** size.
- The larger one directed forward and the smaller one is directed backward.
- A small **perforation** occurs at the **apex** of the unilocular sporangium, and up to 32 haploid zoospores ooze out of the sporangium in a gelatinous matrix.
- The perforation is small, and zoospores are relatively large, being twice the size of gametes and zoospores from plurilocular sporangia.
- The **zoospores** initially **swim** in a **straight** pattern, then display **circling** movements as they explore appropriate **surfaces** for settling.
- The zoospores **germinate** within 2 to 3 hours to produce **haploid filaments**.



Unilocular sporangia



Unilocular sporangia

Asexual Reproduction

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graph TD; A[Asexual Reproduction] --> B[Unilocular zoosporangium (2n)]; A --> C[Plurilocular zoosporangium (2n)]; B -- Meiosis --> D[Haploid zoospore (n)]; D --> E[Haploid gametophyte (n)]; C -- Mitosis --> F[Diploid zoospore (2n)]; F --> G[Diploid sporophyte thallus (2n)];
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Unilocular zoosporangium (2n)

Meiosis

Haploid zoospore (n)

Haploid gametophyte (n)

Plurilocular zoosporangium (2n)

Mitosis

Diploid zoospore (2n)

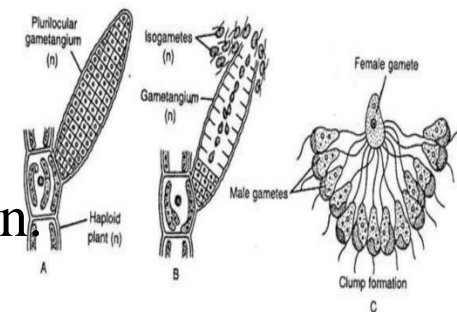
Diploid sporophyte thallus (2n)

Reproduction: Sexual reproduction

- Sexual reproduction takes place by
 - ▣ *Isogamous* and homothallic: *E. pusilus* and *E. globifer* etc.
 - ▣ *Physiological anisogamous* and Heterothallic: *Ectocarpus secundus*.
 - ▣ *Morphological Anisogamy*: *E. secundus* (gametes are produced in different gametangia: microgametangia and megagametangia).
- The gametes are produced in plurilocular gametangia on the **haploid filaments**:
 - ▣ Smaller than those on the diploid filaments,
 - ▣ They produce either gametes or zoospores .
 - ▣ The motile gametes are all of the **same size** but **differ physiologically**.
 - ▣ The **female gametes** settle down about 5 minutes after liberation and secrete a sexual hormone called *ectocarpene* [all cis-1-(cycloheptadien-2,5-yl)-1-butene].

Reproduction: Sexual reproduction.....

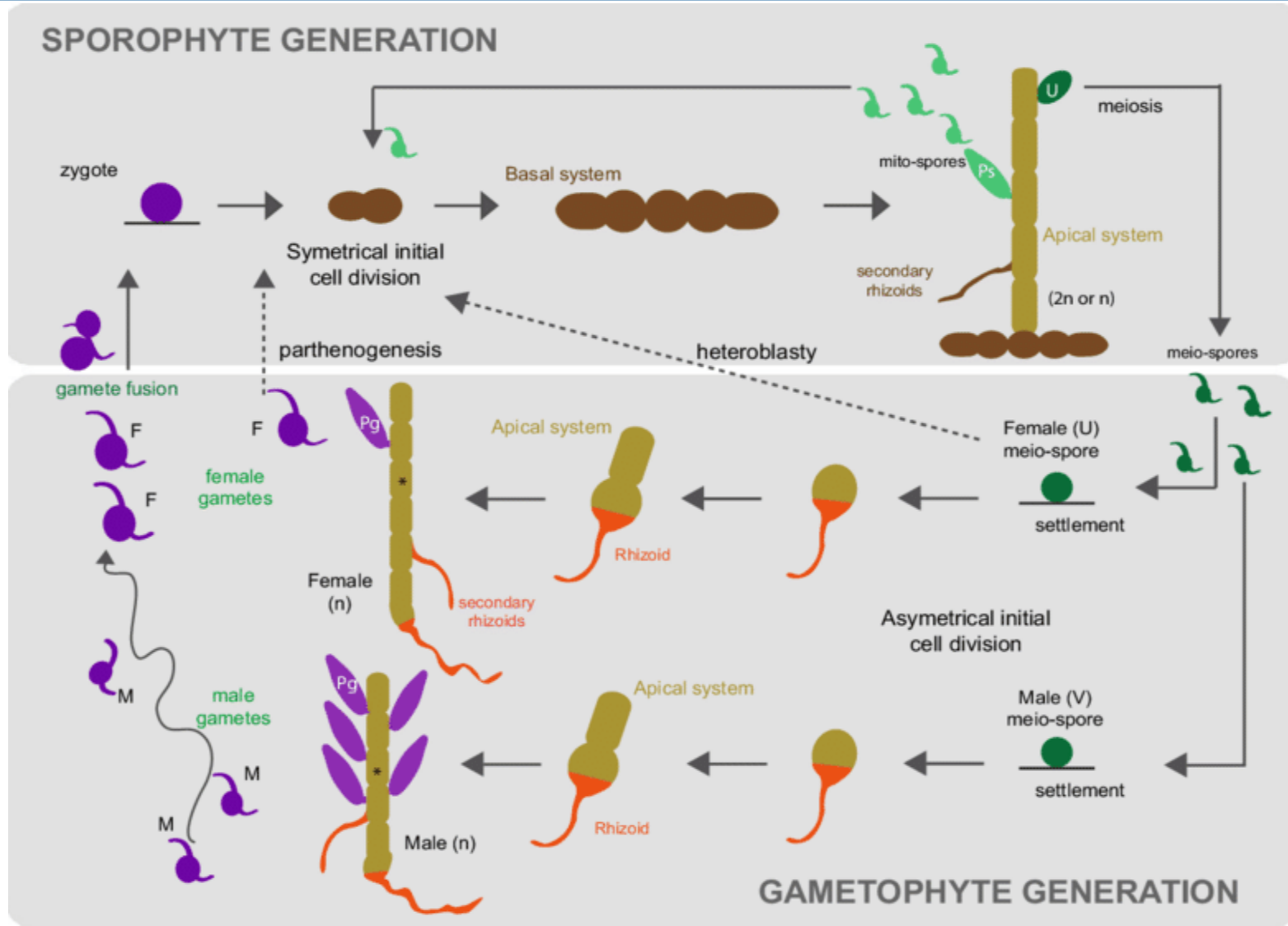
- ❑ The **motile male** gametes swim in circular paths on encountering *ectocarpene*.
- ❑ As soon as the female gamete is reached, a firm contact is established between the apical part of the front flagellum of the male gamete and the plasma membrane of the female gamete.
- ❑ The anchoring flagellum contracts.
- ❑ Therefore, the body of the male gamete comes in contact with that of the female gamete and the fusion takes place.
- ❑ This phenomenon is called *clump formation*.
- ❑ The posterior ends of the two gametes fuse to form the zygote.
- ❑ The zygotes take 2 to 3 days to germinate.
- ❑ Some of the unfused gametes have the ability to germinate **parthenogenetically** to give rise to **haploid** filaments again.



Alternation of Generations

- *Ectocarpus* shows isomorphic alternation of generations.
 - ▣ **Sporophyte:** The sporophyte is diploid and it develops two types of sporangia.
 - **Plurilocular sporangia:**
 - Zoospores are produced by **mitosis** (**mitozoospores**) in plurilocular sporangia.
 - The mitozoospores germinate into a **diploid** sporophyte.
 - These spores cause reduplication of **sporophyte** generation.
 - **Unilocular sporangia:**
 - The zoospores are produced **meiotically** (**meiozoospores**).
 - The meiozoospores germinate to give rise a **haploid** gametophyte plant.
 - ▣ **Gametophyte:** It develops **plurilocular gametangia**.
 - These gametophytes are similar to the sporophyte in morphology.
 - Haploid gametes are produced in the **gametangia**.
 - These gametes **fuse** to form a diploid **zygote**.
 - Zygote germinates into a diploid sporophyte plant.
 - Parthenogenesis: the gametes from plurilocular gametangia form new gametophyte generation.

Alternation of Generations



Economic Importance:

- The important phycocolloids **algin** and **fucoidin** are secondary metabolites used in manufacture of
 - Beer,
 - Tooth paste
 - Ice-cream
 - Paint
 - Shaving creams
 - Medicines
 - Soapes.