

# Algae

## General Account

**Presented By**

**Dr. Dharneswar**

**Barnan Asst**

**Professor Goalpara**

**College**

# Declaration

**The source of Data/Text used in the preparation of power point presentation were Google, E-Books, Books and Journals. It is used for teaching purpose only.**

# Structure of the algal cell

## Prokaryotic cell

- They are found in Cyanophyta.
- Cell wall contains mucopeptide.
- DNA materials are concentrated in the centre and nuclear membrane is absent.
- Chloroplast, Mitochondria, Golgi bodies, Plastids and ER reticulum absent.
- Ribosomes are present.
- Nuclear division doesn't take place by mitosis.

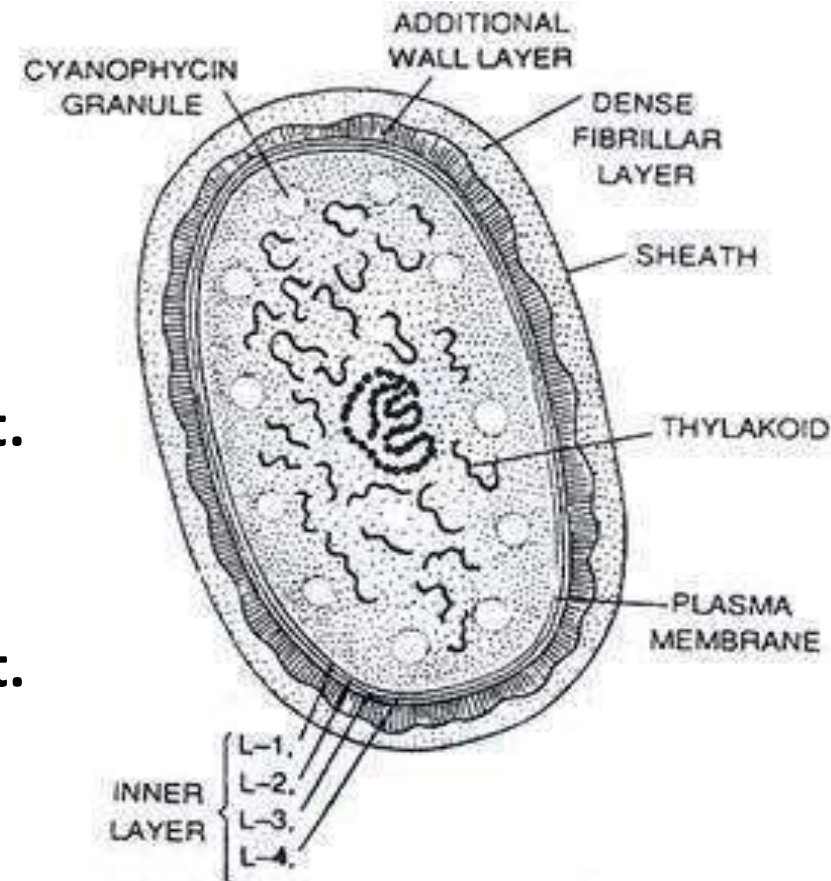
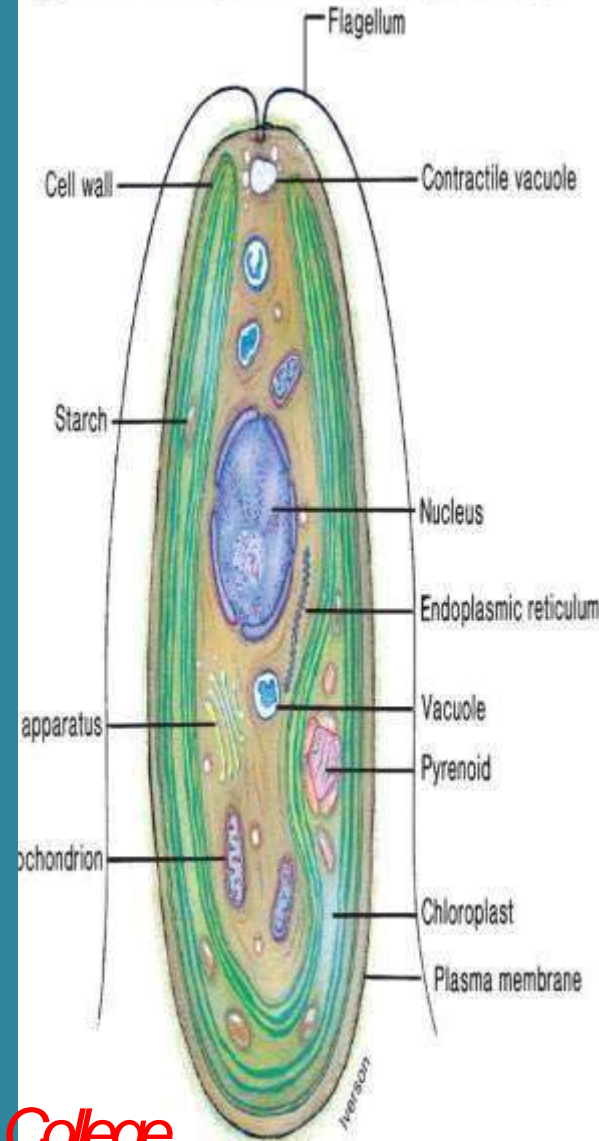


Fig. 2.51. Blue-green algae (Cyanobacteria). *Cylindrospermum*. Ultra structure of an akinete (diagrammatic)

# Eukaryotic cell

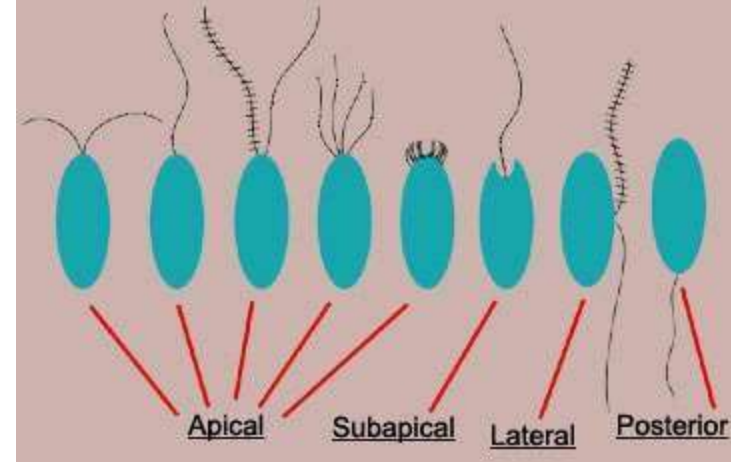
- Eukaryotic cell has the structure as in typical cell of higher plants.
- An intermediate form called **mesokaryotic** occurs in **Dianophyceae** which shows both eukaryotic (nucleus with nuclear membrane & chromosomes) and prokaryotic characters (basic proteins are absent).
- Some do not have **true cell wall** Ex: euglena, gymnodinium & possess a membrane called **pellicle** around cytoplasm.
- Motile flagella possess a pigmented spot known as **eyespot or stigma** (swimming).
- Cell wall is with mixed carbohydrates and substances like alginic acid, fucoidin, fucin & hemicelluloses present.

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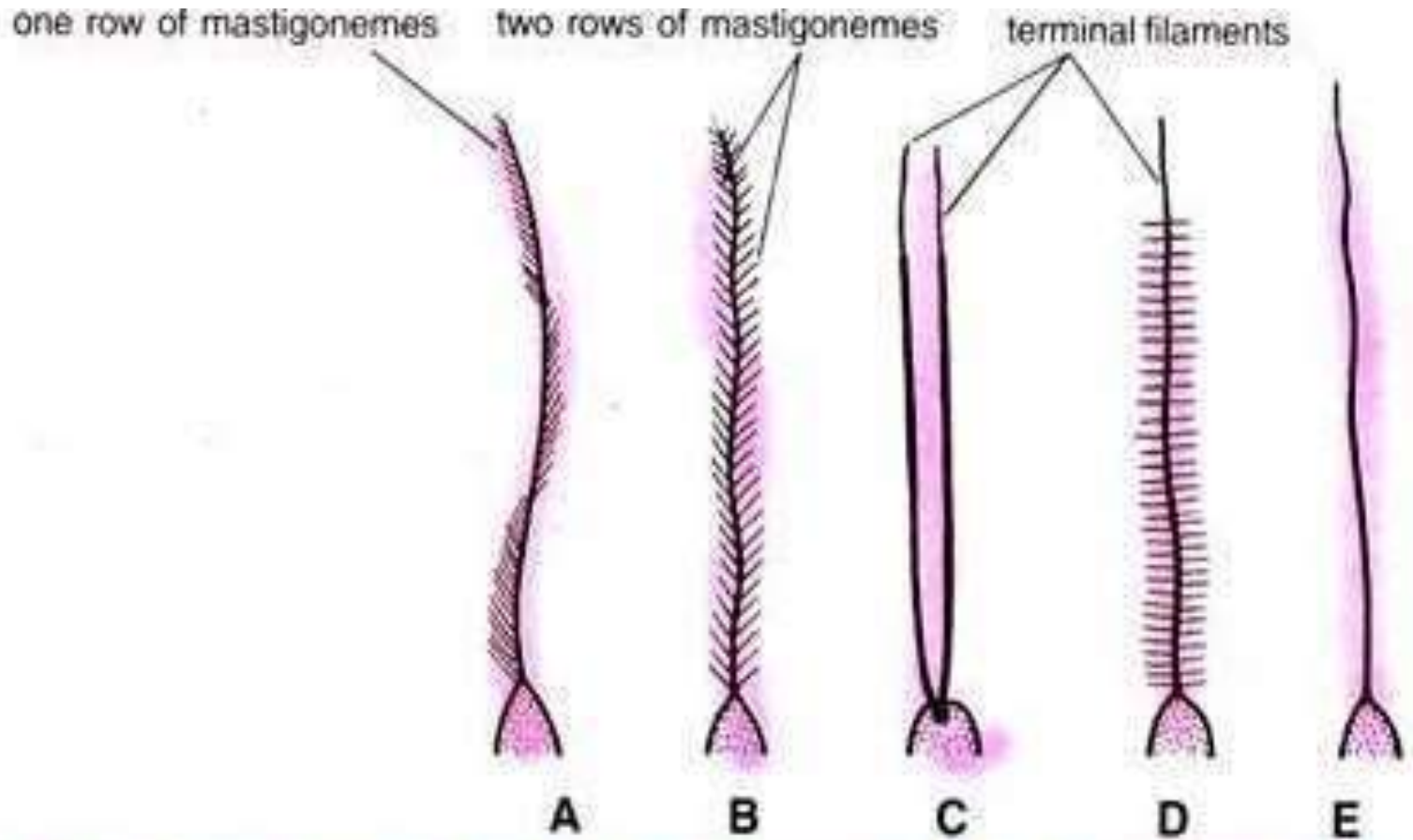


# ALGAL FLAGELLA

- Found in all algae except **Rhodophyceae**.
- The main function is motility.
- They are of 2 types
  - **Whiplash** or acronematic-possess smooth surface
  - **Tinsel** or pleuronematic-covered by fine filamentous appendages called as mastigonemes or flimmers.
- Tinsel is divided into 3 types
  - ✓ **Pantonematic**-mastigonemes arranged in two opposite rows or radially
  - ✓ **Pantocronematic**-Pantonematic flagellum with a terminal fibril
  - ✓ **Stichonematic**-mastigonemes develop only on one side of the flagellum



# Different Types of Flagella



**Fig. 23.4.** Different types of flagella. A—Stichonemate; B—Pantoneurate; C—Acronemate; D—Pentachroneurate; E—Simple.

# Pigment in Algae



*“Green is the prime color of the world, and that from which its loveliness arises...”*

*Pedro Calderon de la Barca*

# PIGMENTS IN ALGAE



## *Pigmentation in algae:*

- Algae show great diversity in pigmentation.
- Green, red, yellow & blue are found in marine and freshwater algae
- Different groups of algae have different and specific pigment composition.
- Pigments found in specialized plastids called chromophores
- Distribution pattern of pigments has great taxonomic significance
- Classification proposed by Fritsch is primarily based on algal pigmentation
- All major algal groups have at least one characteristic pigment in their cells

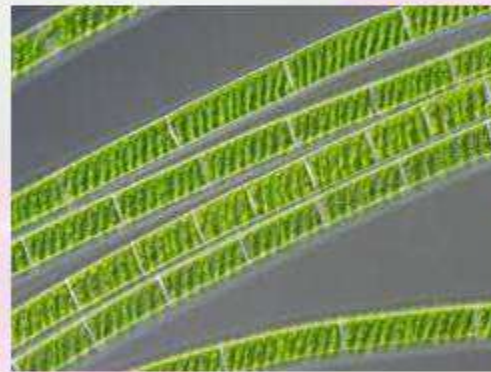


# PIGMENTS IN ALGAE

## *Pigmentation in algae:*

- Pigments in algae belong to **THREE** major categories based on their physical and chemical properties. :

### 1. Chlorophylls



*Green Algae*



*Blue Green Algae*

### 2. Carotenoids



*Brown Algae*



*Red Algae*

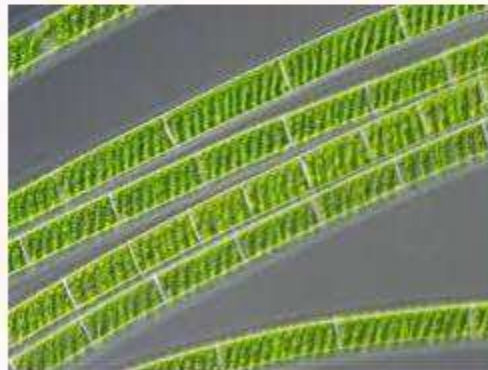
### 3. Phycobilins

# PIGMENTS IN ALGAE



## *(1). Chlorophylls:*

- Chlorophylls are fat soluble green pigments
- They are chlorins which absorb blue region and reflect green light
- Chlorophylls are responsible for the green colour of algae and other higher plants.



*Green Algae*

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# PIGMENTS IN ALGAE



## *(1). Chlorophylls:*

- Seven different types of chlorophylls are reported in algae. They are:

1. ***Chlorophyll-a*** ( $C_{55}H_{72}O_5N_4Mg$ )
2. ***Chlorophyll-b*** ( $C_{55}H_{70}O_6N_4Mg$ )
3. ***Chlorophyll-c1*** ( $C_{35}H_{30}O_5N_4Mg$ )
4. ***Chlorophyll-c2*** ( $C_{35}H_{28}O_5N_4Mg$ )
5. ***Chlorophyll-d*** ( $C_{54}H_{70}O_6N_4Mg$ )
6. ***Chlorophyll-e*** ( $C_{54}H_{70}O_6N_4Mg$ )
7. ***Chlorophyll-f*** ( $C_{55}H_{70}O_6N_4Mg$ )

# PIGMENTS IN ALGAE



## *(1). Chlorophylls:*

### *Distribution of Different Chlorophylls in Different Algal Groups*

- *Chlorophyll-a* : Present in all groups of algae
- *Chlorophyll-b* : Present in Chlorophyta (green algae)
- *Chlorophyll-c* : Present in Bacillariophyceae (diatoms)
- *Chlorophyll-d* : Present in the members of Rhodophyceae (red algae)
- *Chlorophyll-e* : Present in Xanthophyceae.
- *Chlorophyll-f* : Recently discovered chlorophyll from stromatolites

# Function of Chlorophyll

## • **Chlorophyll-A**

- *Used in oxygenic photosynthesis*
- *Chlorophyll-A function as primary electron donor in the electron transport chain for photosynthesis .*
- *Chlorophyll A also transfers resonance energy in the antenna complex, ending in the Reaction center where specific chlorophylls P680 and P700 are Located.*

## **Chlorophyll-B**

- *Absorb energy that chlorophyll a does not Absorb.*
- *Functions as a Light-harvesting Antenna in Photosystem I.*

*Slide prepared by Dr. D. Barman, Asst professor, Goalpara College*

# PIGMENTS IN ALGAE

## (2). Carotenoids:

- Carotenoids are fat soluble yellow pigments
- Found in close association with chlorophylls.
- They protect chlorophylls from photo-damage
- Chemically carotenoids are tetraterpenoids
- Carotenoids are present in almost all algal groups
- Carotenoids with beta-ionone ring have Vitamin-A like activity
- All carotenoids are strong antioxidants



# PIGMENTS IN ALGAE



## *(2). Carotenoids:*

- Two types of carotenoids are found in algae.

*A. Carotenes*

*B. Xanthophylls*

# PIGMENTS IN ALGAE



## (2). Carotenoids:

### (A). Carotenes:

- Carotenes are yellow coloured pigments
- They are unsaturated fat soluble hydrocarbons
- They do not contain oxygen
- They absorb blue and green light and transmit yellow and red light.
- Examples:  $\alpha$ -carotene,  $\beta$ -carotene, and lycopene





# PIGMENTS IN ALGAE



(2). Carotenoids:

## (B). Xanthophylls:

- Xanthophylls are also called as carotelos
- They are oxygen derivatives of carotenes.
- Example: lutein and zeaxanthin (both are responsible for the colour of egg yolk)



# Xanthophyll: FUCOXANTHIN

- Fucoxanthin is a xanthophyll, which performs a limited form of photosynthesis in Brown Algae (Phaeophytes).
- It is responsible for the brown or olive-green colour of these algae.
- Molecular formula  $C_{42}H_{58}O_6$ .
- Fucoxanthin absorbs red light to perform photosynthesis
- The pigment is produced in abundant quantities by the following edible brown algae : *Laminalia japonica*, *Undaria pinnatifida*, *Sargassum fulvellum* etc
- It is a xanthophyll — an oxygenated carotene, or plant pigment

# Xanthophyll: Function

- ❖ Xanthophyll acts as an accessory light harvesting pigment.
- ❖ Have critical structural and functional role in the photosynthesis of plants and algae.
- ❖ Also serve to absorb and dissipate excess light energy, Or work as antioxidants.
- ❖ Xanthophyll may be involved in inhibiting lipid peroxidation.

# PIGMENTS IN ALGAE



## *(3). Phycobilins:*

- Phycobilins are water soluble pigments
- Phycobilins are always bonded with some water soluble proteins called phycobiliproteins
- They are blue and red in colour
- They are present in Cyanophyceae and Red algae
- Phycobilins are usually found in organisms living in deep water for the efficient absorption of light
- All phycobilins are strongly fluorescent
- They emit orange or red light after fluorescence.

# PIGMENTS IN ALGAE



## *(3). Phycobilins:*

- Two classes of phycobilins are present in algae.

A. **Phycocyanins**

B. **Phycoerythrins**



# PIGMENTS IN ALGAE



## *(3). Phycobilins:*

### **(A). Phycocyanin:**

- Phycocyanin are blue coloured pigments
- They absorb green, yellow and red light and transmit blue colour.
- Phycocyanins are the principal pigment of blue green algae.



# Phycocyanin: Function

- ❑ Phycocyanin (Pc) is a phycobiliprotein that has been recently reported to exhibit a variety of pharmacological properties. In this regard, antioxidant, anti-inflammatory, neuroprotective and hepatoprotective effects have been experimentally attributed to Phycocyanin.
- ❑ It reduces carbon tetrachloride (CCl<sub>4</sub>)-induced lipid peroxidation in vivo.
- ❑ Phycocyanin is related to the human pigment bilirubin, which is important to healthy liver function and digestion of amino acids. It imparts its anticancer property to Spirulina.
- ❑ Help in curing anemia

*Slide prepared by Dr. D. Barman, Asst professor, Goalpara College*

# PIGMENTS IN ALGAE



## *(3). Phycobilins:*

### **(B). Phycoerythrin:**

- Phycoerythrin are red coloured pigments
- They absorb blue green, green and yellow light and transmit red light.
- Phycoerythrin present abundantly in members of Rhodophyceae (red algae)



# Phycoerythrin: Function

- ❑ Phycoerythrin is an accessory pigment to the main chlorophyll pigments responsible for photosynthesis.
- ❑ The light energy is captured by phycoerythrin and is then passed on to the reaction centre chlorophyll pair, most of the time via the phycobiliproteins phycocyanin and via allophycocyanin
- ❑ R-Phycoerythrin and B-phycoerythrin are among the brightest fluorescent dyes ever identified

# PIGMENTS IN ALGAE



## *Distribution pattern of different pigments in different algal groups*

	<b>Algal Group</b>	<b>Major Pigments (Principal pigment)</b>
1	Chlorophyceae (Green algae)	Chl-a, Chl-b, $\beta$ -carotene, Xanthophylls
2	Xanthophyceae	Chl-a, $\beta$ -carotene, Xanthophylls
3	Bacillariophyceae	Chl-a, Chl-c, $\beta$ -carotene
4	Phaeophyceae (brown algae)	Chl-a, Chl-c1, Chl-c2, Fucoxanthin, $\beta$ -carotene, Xanthophylls
5	Rhodophyceae (red algae)	Chl-a, Chl-d, $\beta$ -carotene, Phycoerythrin and phycocyanin
6	Myxophyceae	Chl-a, $\beta$ -carotene, Phycocyanin, phycoerythrin

# ALGAE: GENERAL CHARACTERISTICS

## *Plastids in algae:*

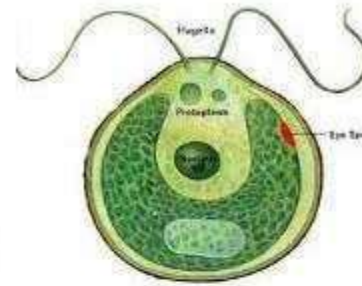
- Except Cyanophyceae (blue green algae, BGA) pigments in algae are found in membrane bound organelles called plastids
- In BGA, plastids are absent, pigments located at peripheral cytoplasm (chromoplasm)
- Plastids are two types:
  - Leuoplast: - Colourless plastids
  - Chromoplast: - Coloured plastids



# ALGAE: GENERAL CHARACTERISTICS

## *Plastid forms in algae:*

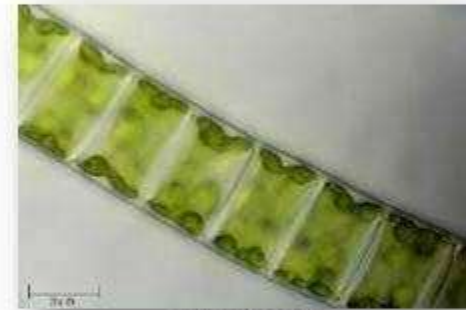
- Cup shaped: *Clamydomonas*, *Volvox*
- Discoid: *Voucheria*, *Chara*
- Girdle shaped: *Ulothrix*
- Reticulate: *Oedogonium*, *Hydrodictyon*, *Cladophora*
- Spiral: *Spirogyra*
- Stellate: *Zygnema*



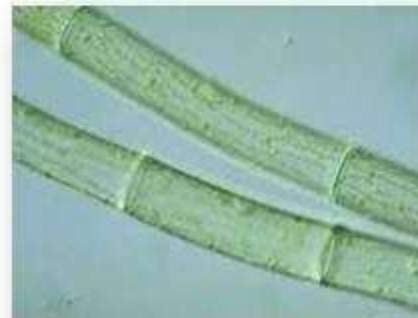
*Clamydomonas*



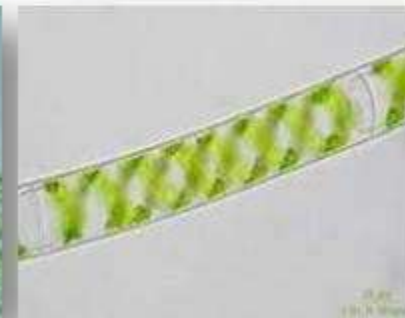
*Voucheria*



*Ulothrix*



*Oedogonium*



*Spirogyra*



*Zygnema*



# ALGAE: GENERAL CHARACTERISTICS

## *Pyrenoids:*

- They are proteinacious bodies present in chromatophores
- Considered as the organelle of synthesis and storage of starch
- In some Chlorophyceae pyrenoids are surrounded by starch grains
- Pyrenoids arise *de-novo* or by the division of pre existing pyrenoids
- Pyrenoids absent in blue green algae

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# FOOD RESERVES

- Food materials accumulated as **polysaccharides**
- **True starch**-seen in two algal divisions chlorophyta and charophyta
- **Floridean starch**- found in rhodophyta
- **Laminarin**- found in brown algae
- **Paramylon**- found in euglenoids
- **Leucosin**-peculiar to xanthophyta , bacillariophyta & chrysophyta
- **Fats** occur as reserved food in appreciable amounts in the cells of xanthophyta , bacillariophyta & chrysophyta

*Thanks for kind attention*