Plant Physiology

Essential life processes that determine how plants grow and develop.

Plant Functions

1. Capture energy & assimilate carbon
2. Distribute nutrients & water.
3. Grow & develop.
4. Respond to the environment
5. Reproduce.....etc.

Plant Cells

Cells are the smallest functional units, Cells differ in size and shape depending on their function.

Why the physiological process are differ from each other?

There are similarities between plants especially higher plants: Containing chlorophyll. However there are differences between them in both morphology and anatomy such differences leads to differences in physiological process. This is the base for the differences of oak tree from tomato plants, it's like the differences between the physiology of cow, sheep, …etc.

What is the importance of this science in human life?

One of the best examples is photosynthesis which can be studied from the point view of academic or applied science.

Therefore crop-physiology has appeared as science which deals with the production and productivity of the plant to ensure the food for population of human being in the world.

What is the relation between this science with the other Sciences?

A strong relationship with different science is present between plant physiology and other science.

For example, Chemistry is well related as all extractions of plants component are active through the chemical extractions, as well as physic and others.

Mathematical models can nowadays be used to determine the yield, production, capability which draws the prediction of the physiological process according to certain programs through computers.

Cell Wall

1. Protects the cellular contents
2. Gives rigidity to the plant structure
3. Provides a porous medium for the circulation and distribution of water, minerals, and other small nutrient molecules
4. Protect the plant from disease.

In plants, each walled cell and its neighbor are cemented together by **a middle lamella**.

The two adjacent primary walls, along with the middle lamella, form a composite structure called the compound middle lamella.

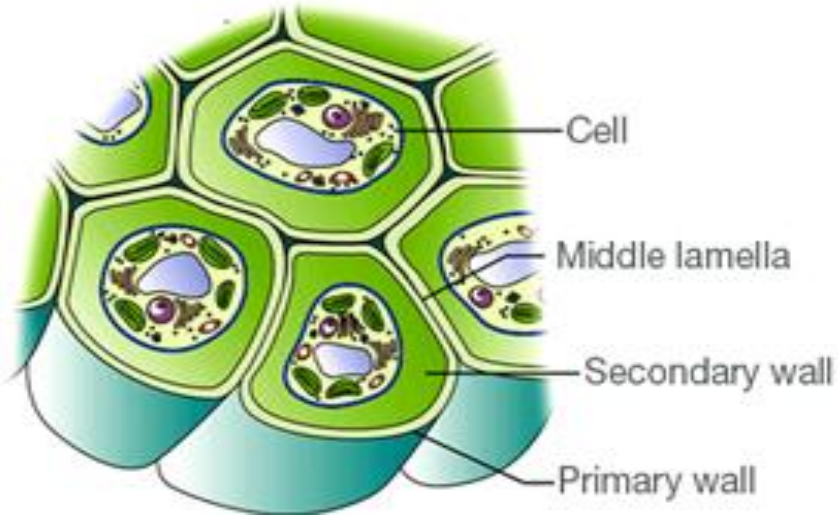
1. Primary cell walls are typically thin (less than 1 μm) and are characteristic of young, growing cells.

Found in all cells; Cellulose fibers parallel to microtubules.

2. Secondary cell walls are thicker and stronger than primary walls and are deposited when most cell enlargement has ended.

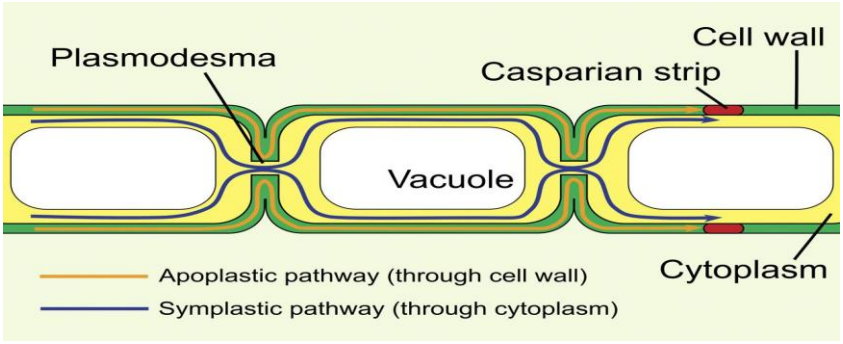
Found in some cells.

Additional layers of cellulose and lignin, increase mechanical strength of wall.



Plasmodesmata

Plasmodesmata are tubular extensions of the plasma membrane, 40 to 50 nm in diameter, that traverse the cell wall and connect the cytoplasm of adjacent cells.



Because most plant cells are interconnected in this way, their cytoplasm form a continuum referred to as the symplast.

Intercellular transport of solutes through plasmodesmata is thus called symplastic transport.

Plasma membrane

All biological membranes have the same basic molecular organization.

They consist of a double layer (bilayer) of phospholipids.

In most membranes, proteins make up about half of the membrane's mass.

Function

1. Regulate traffic.
2. Separate the internal from external environment.
3. Serve as a platform on which some reactions can occur.
4. Participate in some reactions.

Mitochondria are the cellular sites of respiration, a process in which the energy released from sugar metabolism is used for the synthesis of ATP (adenosine triphosphate) from ADP (adenosine diphosphate) and inorganic phosphate.

Mitochondria: "powerhouse" sites of:

1. Cell respiration 2. Glycolysis 3. Krebs cycle

Plastids

Plastids are double-membrane organelles which are found in the cells of plants and algae.

Plastids are responsible for manufacturing and storing of food. These often contain pigments that are used in photosynthesis and different types of pigments that can change the colour of the cell.

Types of Plastide

1. Chloroplast membranes contain chlorophyll and its associated proteins and are the site of photosynthesis.

Both mitochondria and chloroplasts contain their own DNA and protein-synthesizing machinery (ribosomes, transfer RNAs, and other components).

The DNA of these organelles is in the form of circular chromosomes, similar to those of bacteria and very different from the linear chromosomes in the nucleus.

2. Chromoplasts

Chromoplast is the area for all the pigments to be kept and synthesized in the plant. These can be usually found in flowering plants, ageing leaves and fruits. Chloroplasts convert into chromoplasts. Chromoplasts have carotenoid pigments that allow different colours in leaves and fruits.

(Carotenoids are yellow, orange, and red organic pigments that are produced by plants and algae, as well as several bacteria, archaea, and fungi).

Plastids that contain high concentration of carotenoid pigments rather than chlorophyll are called chromoplasts.

When leaves change color in autumn, it is the result of the conversion of chloroplasts into chromoplasts.

3. Leucoplasts

These are the non-pigmented organelles which are colourless. Leucoplasts are usually found in most of the non-photosynthetic parts of the plant like roots. They act as a storage sheds for starches, lipids, and proteins depending on the need of the plants

Oleosomes or lipid bodies

Oleosomes are natural oil droplets, abundant in plants and more specifically in seeds, composing 20–50 wt% of their mass. The structure of oleosomes is the mechanism that seeds developed to safely store energy in the form of triacylglycerols and use it during germination.

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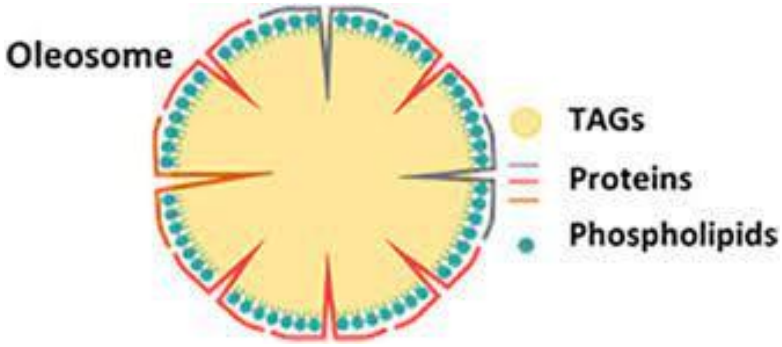


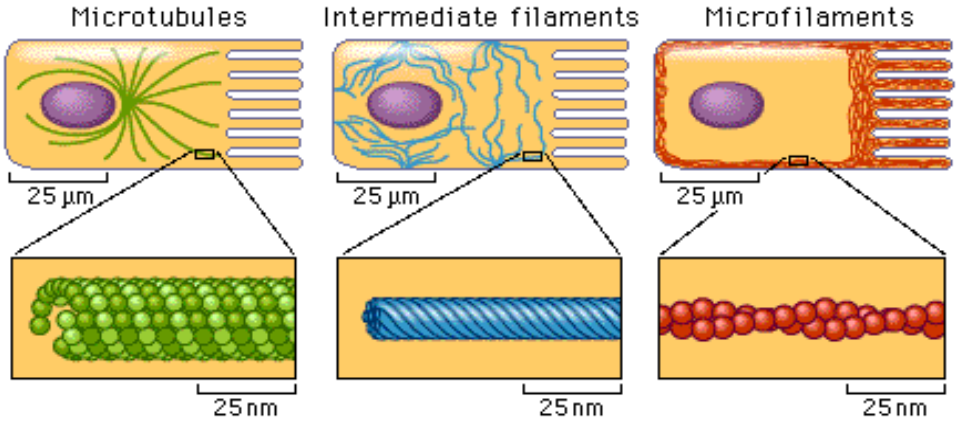
The cytoskeleton

The cytoskeleton made of protein fibers.

Three types of cytoskeletal elements have been demonstrated in plant cells:

1. Microtubules 2. Microfilaments 3. Intermediate filament-like structures.

Each type is filamentous, having a fixed diameter and a variable length, up to many micrometers. It also plays fundamental roles in mitosis, meiosis, cytokinesis, wall deposition, the maintenance of cell shape, cytoplasmic streaming and cell differentiation.



Seed and Germination

The seed is mature, fertilized ovules. Ovules are structures of seed plants (spermatophytes) containing the female gametophyte with the egg cell or the seed is an embryonic plant in dormancy state.

Seed germination

It is awakening of the dormant embryo (the minimum of the physiological activates) as soon as the necessary conditions are satisfied the phenomenon of germination being, which includes/

1- Physical or natural changes.

2- Chemical changes or process of digestion & translocation.

3- Vital changes or embryonic division starting.

Seed structure

Its composed of:

1- Seed coat consists of testa and tegmen: testa (hard) the outer protective layer of the seed and tegmen (soft) the inner layer. Micro Pyle/ is canal or hole in the coverings (seed coat) of the nucleus through which the pollen tube usually passes during fertilization and during the germination, the micro Pyle serve as a minute pore through which water enters.

2. Embryo: composed from embryonic axis which connected with embryonic leaves (cotyledon) the embryo consist from/

Epicotyl …….. Terminate by plumule.

Hypocotyl……. Terminate by radicle.

Embryonic leaves …. (cotyledons).

Storage food..... May be carbohydrate (starch), protein (aleuronic grain) or lipids. This food may be stored in a special tissue called (endosperm) in this case called (endospermic seeds), or stored in cotyledons one or two and in this case called (non-endospermic seed).

Necessary condition for germination

a. External factors

1. Moisture, the seed germination start from 30-40%.

2. Temperature, the optimum temperature 20-35°C.

3. Oxygen, for respiration and energy production.

4. Light, CO_2, optimum ph. Low temp. all them called some special . requirements for an a certain seeds kinds.

b. Internal factors

1. Viability or capacity to germinate, its affected by factors like, plant species, humidity, Temp.

2. Food and plant hormones like auxine.

3. Complete the resting period.

4. Pathogenic agents