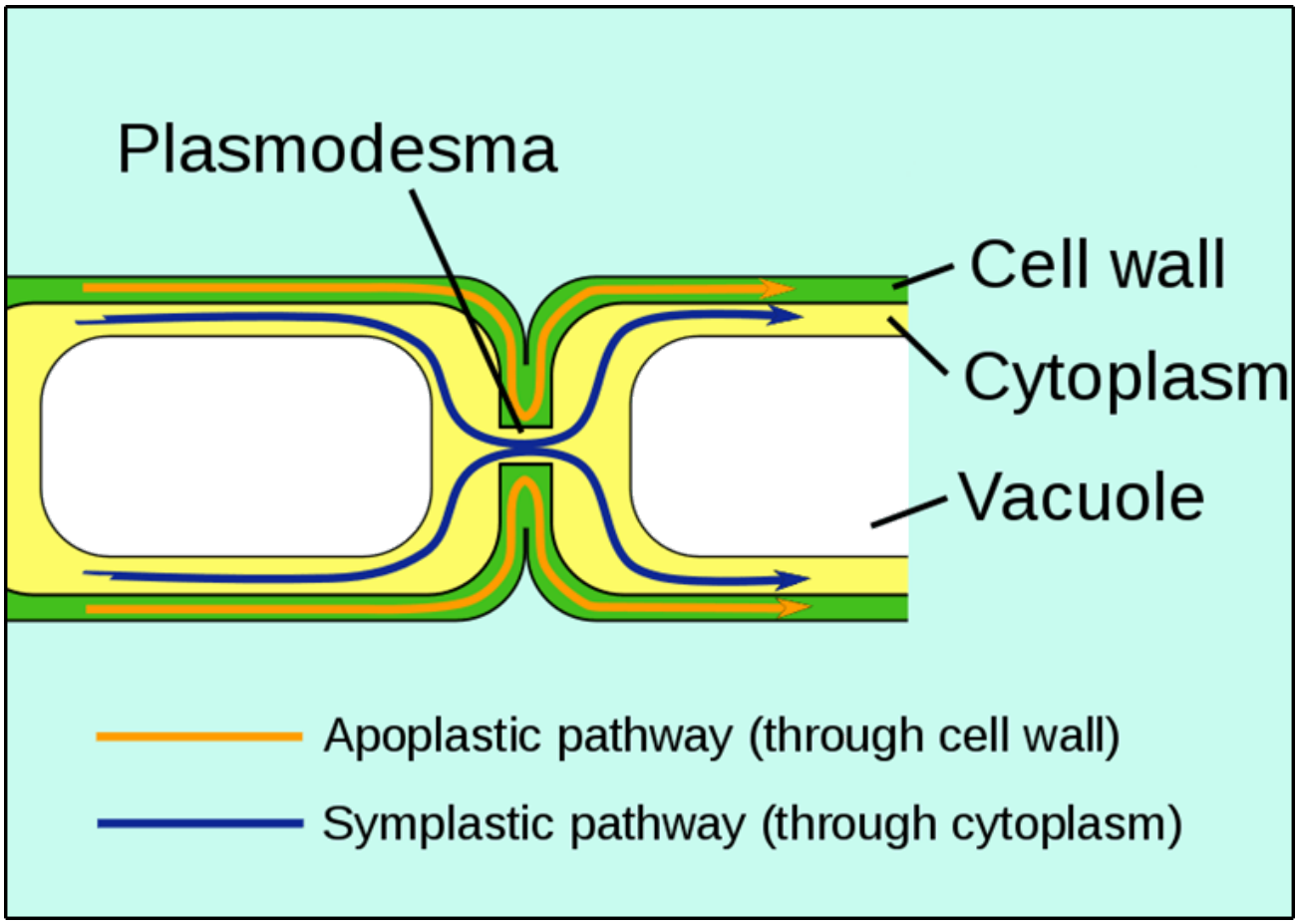
FlexiPrep

Apoplast: Meaning of Apoplast, Significance of Apoplast, Apo Plastic Transport (For CBSE, ICSE, IAS, NET, NRA 2022)

Meaning of Apoplast

- The space outside the plasma membrane within which material can diffuse freely is known as the apoplast.
- The term apoplast was coined in 1930 by Münch (A German plant physiologist who proposed the Pressure Flow Hypothesis in 1930) to separate the “living” symplast from the “dead” apoplast.
- Apoplast is formed by the continuum of cell walls of adjacent cells as well as the extracellular spaces.
- A tissue level compartment comparable to the symplast.
- The facilitation of water and solutes across a tissue or organ occurs through apo plastic route and the process is known as apo plastic transport.
- The main carbon source (carbon dioxide) needs to be solubilized in the apoplast.
  - Before it diffuses through the plasma membrane into the cell’s cytoplasm (symplast) .
  - Used by the chloroplasts during photosynthesis.
- Ions diffuse into the apoplast of the epidermis before diffusing into the symplast in the roots.
- All gaseous molecules emitted and received by plants such as plant hormones and other pheromones must pass the apoplast.



Significance of Apoplast

- It is crucial for all the plant's interaction with its environment.
- It also plays an important role in resistance to aluminum toxicity and resistance.

- It also provides resistance to chemicals.
- The apoplast provides the rich environment for microorganism's endophytes.
  - Arises the abiotic resistance of plants.
- Exclusion of aluminum ions in the apoplast prevent toxic levels.
  - Inhibit shoot growth, reducing crop yields.

Apo Plastic Transport

- For water transport in plants, the apo plastic pathway is one of the two main pathways other one is the symplastic pathway.
- During apo plastic transport, water, and minerals flow in an upward direction via the apoplast to the xylem in the root.
- Transport velocity is higher in the apoplast than the symplast.
- Through a combination of import from the xylem, absorption by cells, and export by the phloem, the concentration of solutes transported in aboveground organs.
- The apo plastic pathway is also involved in passive exclusion.
- Not all the ions enter through the roots making it to the xylem.
- The plasma membrane excludes the ions of the endodermal cells.

Apo Plastic Colonization

- Black rot is the common apo plastic disease appear in plants without restricted habitat or climate.
  - Caused by the gram-negative bacteria Xanthomonas campestris.
- Apoplast is a popular biotic interface and a reservoir for microbes.
- When pathogens enter the plants from leaves, the first place they come across is the apo plastic space.
- The major component of the volatiles is phytotoxic in rhizobacteria.
  - It is identified as 2-phenylethanol.
  - 2-phenylethanol can influence the regulation of WRKY18.
  - 2-phyenlethanol modulates the sensitivity of ABA through WRKY18 and WRKY40.
- The microbial colonization can be beneficial to establish a symbiotic relationship with the host.
- The endophytic and phyllosphere microbes can indirectly promote plant growth and protect the plant from other pathogens.
  - By inducing salicylic acid (SA) and jasmonic acid (JA) signaling pathways.

Symplast

- The inner side of the plasma membrane in which water and low-molecular-weight solutes can freely diffuse is known as the symplast.
- The symplastic transport was first realized by Eduard Tangl in 1879.
- Hanstein (A German botanist who was a native of Potsdam) coined the term symplast in 1880.
- There is presence of more than two nucleus in symplast.

- The direct flow of small molecules such as sugars, amino acids, and ions between cells is allowed by the plasmodesmata.
- Molecules like transcription factors and plant viruses which larger can also be transported through with the help of actin structures.

Tonoplast

- A membrane which bounds the chief vacuole of a plant cell is called Tonoplast.
- It surrounds the central or large vacuole of the plant.
- By bringing in protons, the tonoplast must work to keep the vacuole acidic.
  - This allows the vacuole's enzymes to break down food matter.
- The potassium is pumped into and out of the vacuole by the tonoplast.

Vacuolar Pathway

- This is the movement of water molecules in plant cells via the vacuoles located in the cytoplasm of the cell.
- The water molecules encounter high resistance.
  - Little flow usually occurs making this pathway insignificant.
- Water moves by osmosis across the vacuoles of the cells of the root system.
- The water moves down a concentration gradient from the soil solution to the xylem.

FAQs

Q 1. What is an apoplast?

Answer:

The space outside the plasma membrane within which material can diffuse freely is known as the apoplast.

Q 2. Is apoplast active or passive absorption?

Answer:

Apoplast is the passive absorption that takes place through the apoplast of the root which in turn comprises cell wall and intercellular spaces.

Q 3. Define Tonoplast.

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