ULTIMATE KCET

CRASH COURSE 2026

Botany | Lecture - 01

Respiration in plants, Plant growth and development

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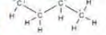
Topics *to be covered*

1. Respiration in plants
2. Plant growth and development.
3.
4.

- Heterotrophs → Herbivores (directly depend on plants)
  → Carnivores (indirectly depend on plants)
- Saprophytes (Fungi) → depend on dead & decaying matter

skeleton produced → used as precursors for biosynthesis



- Cellular Respiration → breaking of C-C bond of complex compounds via oxidation & release energy

Respiratory Substrate
- Generally carbs
- protein, fats, organic acids (in certain condⁿ)

→ all energy not released free to cell or in single step
→ it released in series of slow stepwise reaction
→ it is controlled by enzymes.
* It trapped as chemical energy in the form of ATP
Energy currency of cell

② Do plant breath ?

- plants not have specilised organ but have Stomata & lenticels.

Q: why plants live without respiratory organs ?

⇒ First, each plant part takes care of its own gas-exchange needs. There is very little transport of gases from one plant part to another. Second, plants do not present great demands for gas exchange. Roots, stems and leaves respire at rates far lower than animals do. Only during photosynthesis are large volumes of gases exchanged

Third, the distance that gases must diffuse even in large, bulky plants is not great. Each living cell in a plant is located quite close to the surface of the plant. → leaves

In stems, the 'living' cells are organised in thin layers inside and beneath the bark. They also have openings called lenticels. The cells in the interior are dead and provide only mechanical support. Thus, most cells of a plant have at least a part of their surface in contact with air. This is also facilitated by the loose packing of parenchyma cells in leaves, stems and roots, which provide an interconnected network of air spaces. → thick woody stems

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★ The complete combustion of glucose, which produces CO_2 and H_2O as end products, yields energy most of which is given out as heat.

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{Energy}$$

not all the liberated energy goes out as heat. The key is to oxidise glucose not in one step but in several small steps enabling some steps to be just large enough such that the energy released can be coupled to ATP

③ Glycolysis (breakdown of Glucose)

- 10 step rxn
- 10 enzymes

Glucose
ATP → Hexokinase → ADP
G-6-P (Glucose-6-phosphate)
↓ isomerase
F-6-P (Fructose-6-phosphate)
ATP → Kinase (PFK) → ADP
F-1,6-BP (Fructose-1,6-bisphosphate)
↓ Aldolase

DHAP ⇌ PGAL (isomerase)
Dihydroxy acetone phosphate

PGAL / G-3P (Phosphoglyceraldehyde / Glucose-3-phosphate / Triose phosphate)

NAD⊕ + NADH + H⊕ → dehydrogenase

1,3-BPGA (1,3 Bisphosphoglyceric acid)

SLP: ADP → Kinase → ATP

3-PGA (3-phosphoglyceric acid)

↓ M

2-PGA (2-phosphoglyceric acid)

↓ E, H_2O

PEP (Phosphoenol pyruvate)

SLP: ADP → Kinase → ATP

Pyruvate

partial oxidation

2ATP consumed; 4 ATP produced; Net ATP: 4 − 2 = (2)

④ Imp points of Glycolysis

- In both Aerobic & Anaerobic organism
  - {In anaerobs: it is only process Respiration}
- occcu in cytoplasm/cytosol
- common respiratory pathway in all organism
- Balance sheet

Input	output	∴ Net gain
• 1 Glucose	• 2 pyruvate	• 2 pyruvate
• 2 ATP	• 4 ATP (SLP)	• 2 ATP (SLP)
• $2NAD^+$	• $2NADH + H^+$	• $2NADH + H^+$
	• $2H_2O$	• $2H_2O$

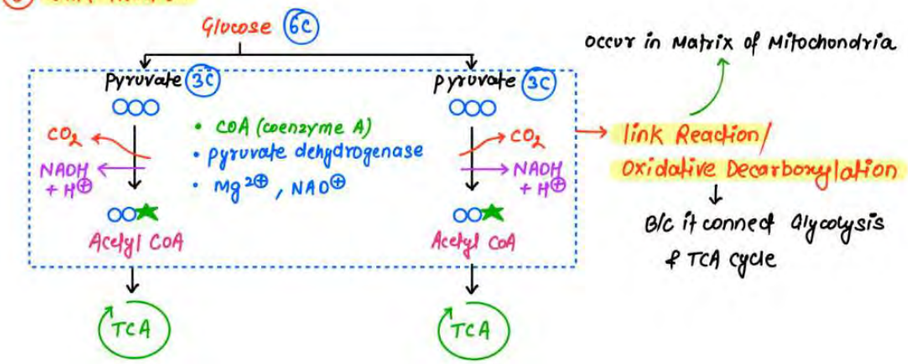
- Discovered by:
  - → Embden, Negerhof & Parnes
  - ∴ called EMP pathway
- Sucrose —invertase→ Glucose + Fructose
- Reversible step: (7) (eg: DHAP ⇌ PGAL)
- Irreversible step: (3) (HK, PFK, PK)
  - chief regulator/pacemaker
- End product of photosynthesis
  - Sucrose —invertase→ Fructose + Glucose
  - —partial Oxidation (Glycolysis)→ Pyuriac acid (Key product of Glycolysis)

⑤ Fate of pyruvate

1 Glucose
↓
2 pyruvate

- Anaerobic Respiration
  - ↓ Fermentation
    - → lactic Acid Fermentation
    - → Alcoholic Fermentation
- Aerobic Respiration
  - O_2
  - Mitochondrial Matrix
    - Link Reaction / Oxd^x Decar^x
    - Kreb cycle

(6) Link Reaction



occur in Matrix of Mitochondria

link Reaction / Oxidative Decarboxylation

↓

B/c it connect Glycolysis & TCA cycle

★

$$\text{Pyruvic acid} + \text{CoA} + \text{NAD}^+ \xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}} \text{Acetyl CoA} + CO_2 + \text{NADH} + H^+$$

Acetyl CoA → Krebs cycle

(7) Aerobic Respiration

For aerobic respiration to take place within the mitochondria, the final product of glycolysis, pyruvate is transported from the cytoplasm into the mitochondria. The crucial events in aerobic respiration are:

- The complete oxidation of pyruvate by the stepwise removal of all the hydrogen atoms, leaving three molecules of CO_2. (one cycle)
  - Link Rxn
  - Krebs cycle
- The passing on of the electrons removed as part of the hydrogen atoms to molecular O_2 with simultaneous synthesis of ATP. (H^+, e^-)
  - ETS

What is interesting to note is that the first process takes place in the matrix of the mitochondria while the second process is located on the inner membrane of the mitochondria.

Pyruvate, which is formed by the glycolytic catabolism of carbohydrates in the cytosol, after it enters mitochondrial matrix undergoes oxidative decarboxylation by a complex set of reactions catalysed by pyruvic dehydrogenase. The reactions catalysed by pyruvic dehydrogenase require the participation of several coenzymes, including NAD^+ and Coenzyme A.

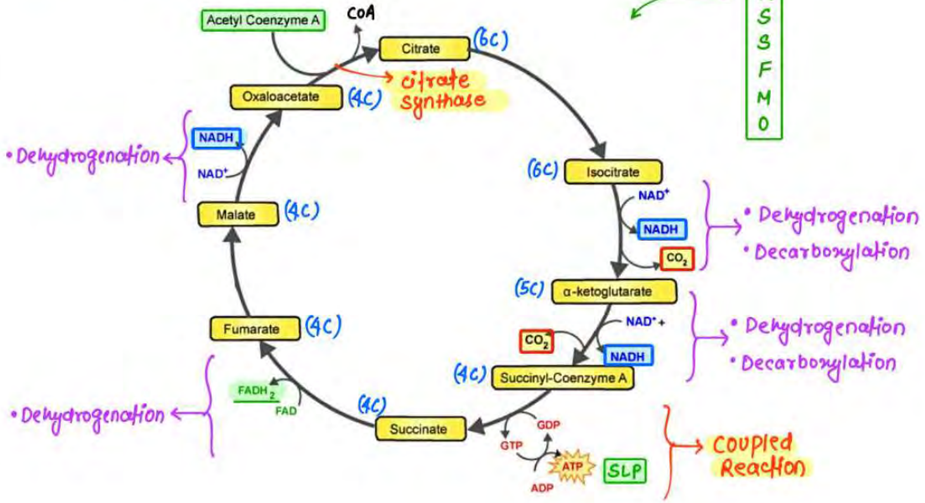
$$\text{Pyruvic acid} + \text{CoA} + \text{NAD}^+ \xrightarrow[\text{Pyruvate dehydrogenase}]{Mg^{2+}} \text{Acetyl CoA} + CO_2 + \text{NADH} + H^+$$

During this process, two molecules of NADH are produced from the metabolism of two molecules of pyruvic acid (produced from one glucose molecule during glycolysis).

The acetyl CoA then enters a cyclic pathway, tricarboxylic acid cycle, more commonly called as Krebs' cycle after the scientist Hans Krebs who first elucidated it.

(8) Kreb cycle / TCA cycle

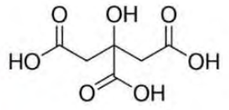
C I K S S F M O



(9) Imp points of Kreb cycle

- Discovered by Hans Kreb
- occur in Matrix of Mitochondria
- Kreb cycle also called ⟶ TCA cycle, citric Acid cycle
- 8th step Reaction
- Net gain: (each cycle) 3NADH, $1FADH_2$, $2\ CO_2$, 1ATP (SLP)

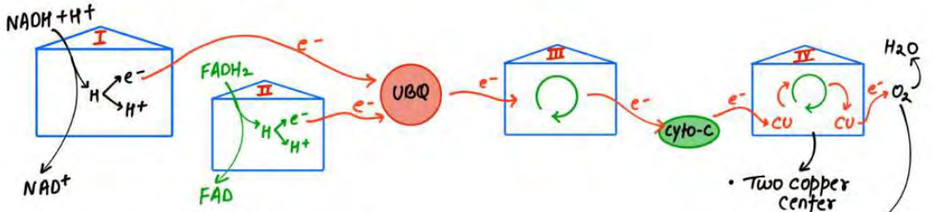
* 1st step: OAA + A·coA + H_2O $\xrightarrow{\text{citrate synthase}}$ citric Acid (3-carb-acid)



(10) Balance sheet (from 1-Glucose)

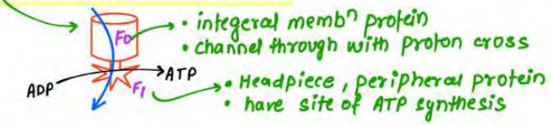
	ATP	NADH	$FADH_2$	CO_2
Glycolysis (cytoplasm)	2	2	0	0
Link Reaction (Matrix)	0	2	0	2
Kreb cycle (Matrix)	2	6	2	4
(SLP) ←	4ATP	10NADH	$2FADH_2$	$6CO_2$

(11) Electron transport system

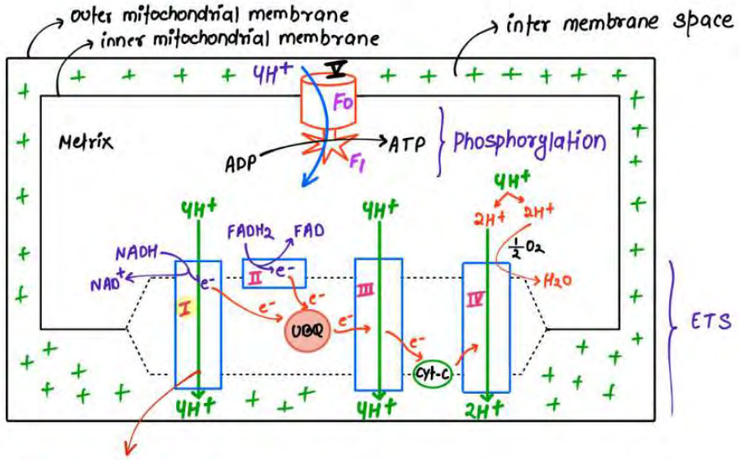


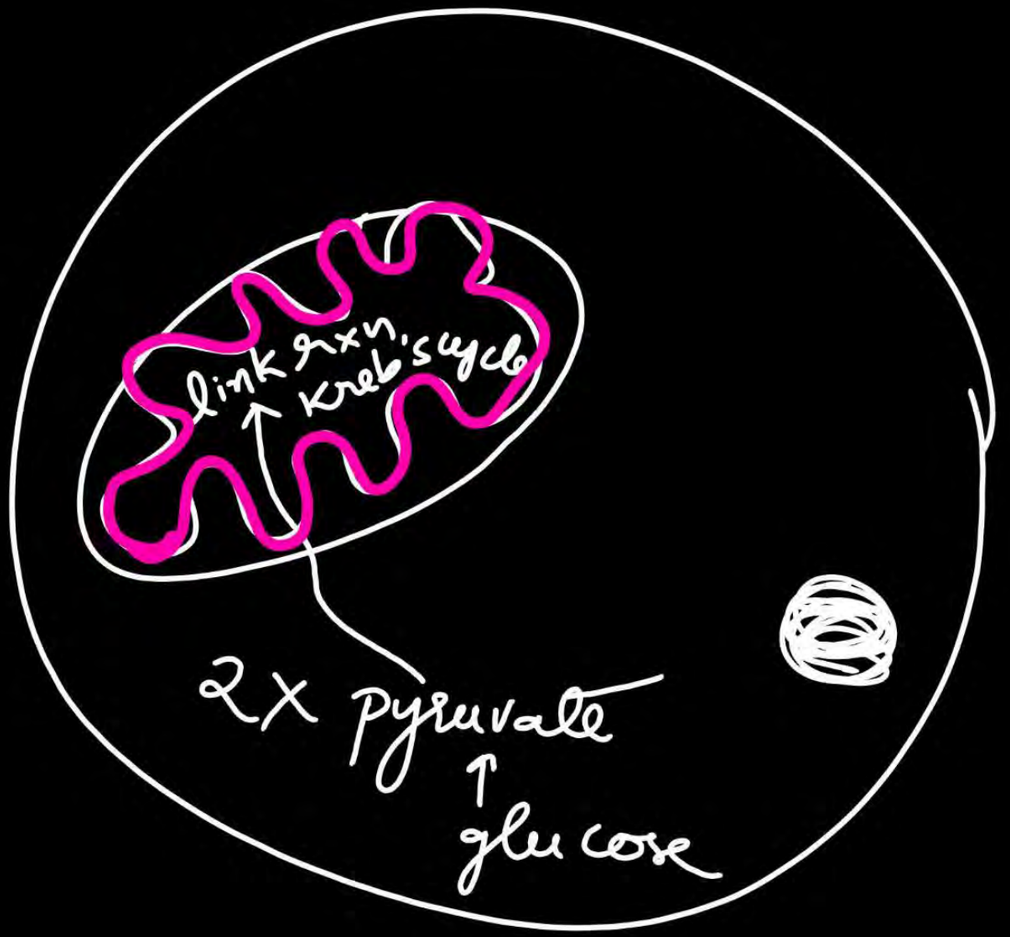
*• Complex-I : NADH Dehydrogenase
• complex-II : Succinate Dehydrogenase
• UBQ : UBIQUINONE
• Complex-III : Cytochrome-bc1
• complex-IV : cytochrome a & a3
• Cyto-C : cytochrome-C
• complex-V : ATP synthase → Fo, F1

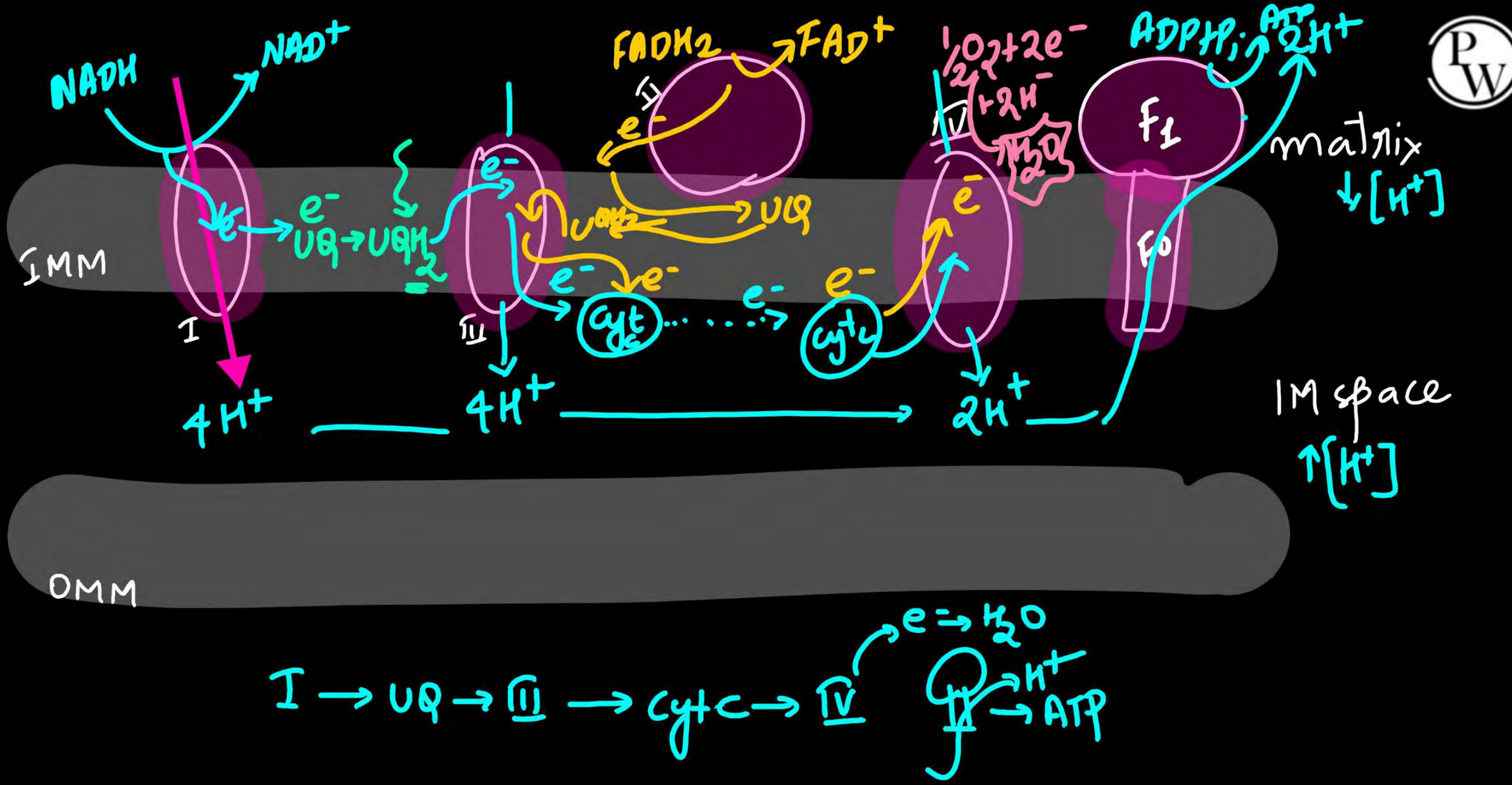
*• Intrinsic protein : I/III/IV/Fo
• extrinsic protein : II / cyto-c / F1
• mobile carrier : UBQ/cyto-c
• Non-protein part : UBQ



(12) Oxidative phosphorylation




link rxn
kreb's cycle
2X pyruvate
glucose



$$I \rightarrow UQ \rightarrow III \rightarrow cyt\,c \rightarrow IV \quad (e^- \rightarrow H_2O;\ H^+ \rightarrow ATP)$$

(13) Mechanism:

- Due to flow of e^- from complex-I to complex-IV
  - These complex will energies & start pumping $H^{\oplus}$ ions from Matrix to inter membrane space of mitochondria
  - ∴ Accumulation of $H^{\oplus}$ ion in inter membrane space
  - $4H^+$ ions moving from 'F_o' of complex-V
  - induce conformational changes in F_1
  - ATP synthesis

★ ATP After ETS

★ 1 NADH = 3 ATP
1 $FADH_2$ = 2 ATP

Net gain: 4 ATP + 10 NADH + 2 $FADH_2$
(From Glucose)
30 ATP ← ETS → 4 ATP

∴ Total ATP = 4 ATP (SLP) + 34 ATP (OP) = **38 ATP**
OP → ETS

(14) Fermentation

lactic acid ← O_2 ↓ (muscle) pyruvate → (lower orgaism: yeast, bacteria) Alcohol

lactic acid fermentation

- Glucose → 2 pyruvate (2 ATP, 2 NADH) —LAD→ lactic acid (NAD^+)
- muscles / RBC
- CO_2 Not formed (Decarboxylation ⊗)

Alcoholic fermentation

- Glucose → 2 pyruvate (2 ATP, 2 NADH) —PDC + AD→ 2 Alcohol + CO_2 (NAD^+)
- lower orgaism (yeast, Bacteria)

* Max^m conc^n of alcohol reaches to 13%, after that yeast will suicide due to lack of Nutrients & accumulation of toxins

lactic acid fermentation	Alcoholic fermentation
• Cytosol • incomplete oxidation • Net Gain = 2 ATP • NADH → Slowly break • less than (7%) energy released • Lactate dehydrogenase	• Cytosol • incomplete oxidation • Net Gain = 2 ATP → • 2 ATP: (from glucose) • 0 ATP: (from pyruvate) • NADH → Slowly break • less than (7%) energy released • Pyruvic acid decarboxylase + Alcoholic dehydrogenase

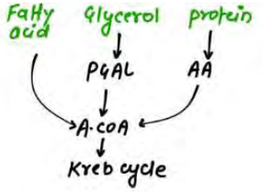
- NADH Breakdown → Vigrously
- NADH Breakdown → Slowly

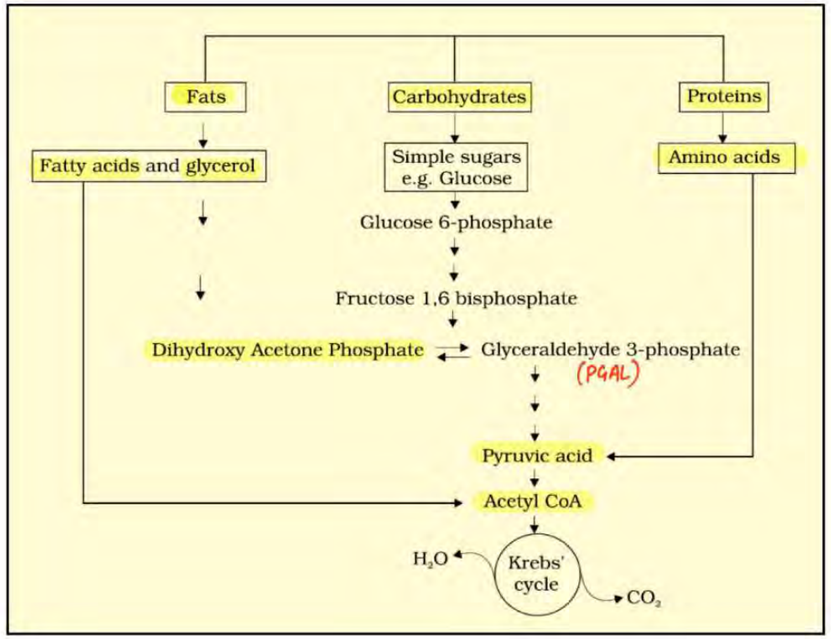
(16) Amphibolic pathway

Breakdown of different organic molecule

Glucose is the favoured substrate for respiration. All carbohydrates are usually first converted into glucose before they are used for respiration. Other substrates can also be respired, as has been mentioned earlier, but then they do not enter the respiratory pathway at the first step.

Fats would need to be broken down into glycerol and fatty acids first. If fatty acids were to be respired they would first be degraded to acetyl CoA and enter the pathway. Glycerol would enter the pathway after being converted to PGAL. The proteins would be degraded by proteases and the individual amino acids (after deamination) depending on their structure would enter the pathway at some stage within the Krebs' cycle or even as pyruvate or acetyl CoA.





(17) Respiratory pathway → Amphibolic pathway → catabolism + Anabolism

Since respiration involves breakdown of substrates, the respiratory process has traditionally been considered a catabolic process and the respiratory pathway as a catabolic pathway. But is this understanding correct? We have discussed above, at which points in the respiratory pathway different substrates would enter if they were to be respired and used to derive energy. What is important to recognise is that it is these very compounds that would be withdrawn from the respiratory pathway for the synthesis of the said substrates. Hence, fatty acids would be broken down to acetyl CoA before entering the respiratory pathway when it is used as a substrate. But when the organism needs to synthesise fatty acids, acetyl CoA would be withdrawn from the respiratory pathway for it. Hence, the respiratory pathway comes into the picture both during breakdown and synthesis of fatty acids. Similarly, during breakdown and synthesis of protein too, respiratory intermediates form the link. Breaking down processes within the living organism is catabolism, and synthesis is anabolism. Because the respiratory pathway is involved in both anabolism and catabolism, it would hence be better to consider the respiratory pathway as an **amphibolic pathway** rather than as a catabolic one.

A/R

(18) Respiratory Quotient (RQ)

$$RQ = \frac{\text{volume of } CO_2 \text{ evolved}}{\text{volume of } O_2 \text{ consumed}}$$

→ output gas

→ input gas

$$RQ = \frac{CO_2}{O_2}$$

- Carbohydrates: RQ = 1
- Proteins: RQ = 0.9
- Fats: RQ = 0.7 (Tripalmitin)
- Alcoholic fermentation: $RQ = \frac{CO_2}{0_2} = \infty$

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + \text{Energy}$$

$$RQ = \frac{6CO_2}{6O_2} = 1.0$$

$$2(C_{51}H_{98}O_6) + 145O_2 \longrightarrow 102CO_2 + 98H_2O + \text{energy}$$

Tripalmitin

$$RQ = \frac{102CO_2}{145O_2} = 0.7$$

* In living organism Respiratory substrate > 1
* pure protein & pure fats → Never used as respiratory substrate

Growth + differentiation

① Growth

- most fundamental characteristics of living being
- Irreversible permanent increase in size
- By Metabolic process (anabolic + catabolic)

* Plant Growth: → unique (B/c plant have capacity for unlimited growth due to presence of meristematic tissue at certain location.)
  - → open growth → indeterminate / determinate
  - → cell division, self-perpetuate

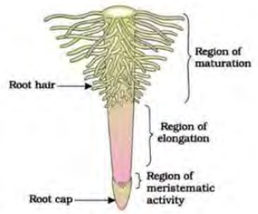
* Growth → measurable ✓

Growth at cellular level due to inc. in protoplasm.
∵ inc. in protoplasm is difficult to measure
∴ Growth is measured by variety of parameters
- fresh weigh
- dry weight
- length
- Surface Area
- volume
- cell number

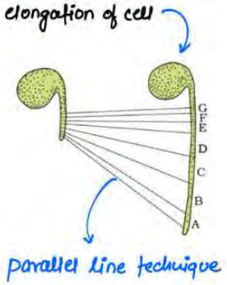
eg:
* single maize (root apical meristem) —make→ 17500 new cell/hour (cell number)
* watermelon → inc. size upto 350000 times (cell size)
* pollen tube —Growth→ length↑, Surface Area↑

② Phase of Growth

Meristematic phase
- constantly dividing cells
- Root apex & shoot apex
- Protoplasm Rich
- large nuclei
- cell wall: primary, thin, cellulosic, plasmodesmatal connt.



Elongation phase
- vacuolation (vacoule form^n)
- cell enlargement
- New cell wall deposition
- elongation of cell

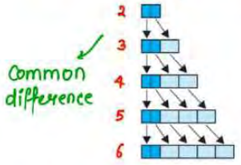


parallel line technique

Maturation phase
- max^m wall thickening
- protoplasmic modification
- Most of tissue, cell type ✓

③ Growth Rates = Growth / Time

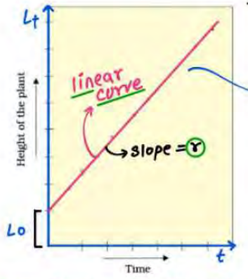
Arithematic growth



Common difference

mitotic cell division

- one daughter cell → Division continue
- other daughter cell → differentiates & mature

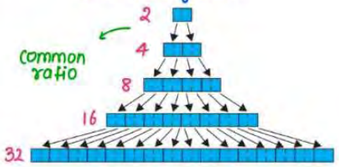


$L_t = L_o + rt$

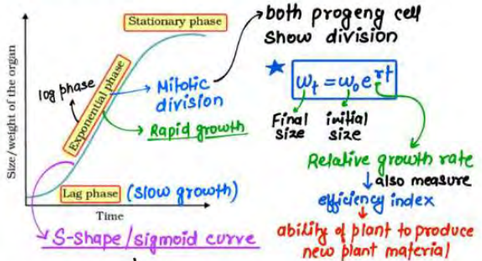
growth rate (or) elongation / time

eg: • Root elongation of constant rate
• later state of embryonic development

Geometric growth



Common ratio



Mitotic division

Rapid growth

(slow growth)

S-shape / sigmoid curve

both progeny cell show division

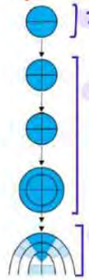
$W_t = W_o e^{rt}$

Final size, initial size

Relative growth rate
↓ also measure
efficiency index
↓
ability of plant to produce new plant material

eg: • living organism grow in natural envmt
• All plant cells, tissue, organs.
• Tree showing seasonal activities
• initial state of embryonic development

* Embryonic development



Zygote development

Geometric phase (initial state of embryonic development)

Arithmetic growth (later state of embryonic development)

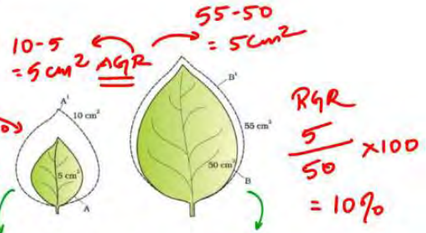
* Quantitative comparisons

Absolute growth rate

$\frac{\text{Total growth}}{\text{total time}} = \frac{\Delta q}{\Delta t}$

relative growth rate

$\frac{\text{Total growth}}{\text{initial growth}} = \frac{\Delta q}{q_i}$



Relative = $\frac{10-5}{5} \times 100 = 100\%$

Relative = $\frac{55-50}{50} \times 100 = 10\%$

★ Condition for Growth

- Water: → Cell enlargement; → Turgidity → extension growth; → medium for enzymatic activities
- O_2: Release metabolic energy → Growth activities
- Nutrients (macro, micro): → Synthesis of protoplasm; → act as energy source
- Tempr: every plant has their optimum Tempr range
- Environmental signals: light, gravity

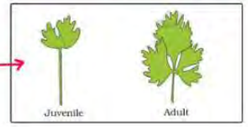
④ plasticity

ability of plant to follow different pathways in Response environment / phases of life

→ Represented by Heterophylly (diff leaf)

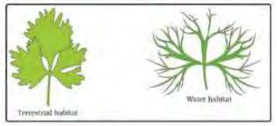
eg: Developmental plasticity → Juvenile / Adult

- cotton
- coriander
- Larkspur →



Environmental plasticity → Terrestrial / water

- Buttercup (Ranunculus) →



⑤ Development

* Growth, differentiation & development } very closely related event

→ Development = Growth + differentiation

- Intrinsic factors
  - Intracellular → Genetic
  - Intercellular → PGR
- Extrinsic factors → Tempr, light, water, CO_2, oxygen, nutrition, etc

★ Many of extrinsic factor like Tempr & light → control plant growth & develop via PGR → such event are

- vernalisation, flowering, dormancy, Seed germn, plant movt.

Differentiation

- Cell undergo few/major structural changes in both cell wall & protoplasm
- cell lose their dividing capacity
- Cells of Root & shoot apical meristems & cambium → diff & mature

eg: • Tracheary element (Lignin)
- cell lose protoplasm
- develop lignocellulosic sec. cell wall

De-Differentiation

- Regain capacity of division

eg: • Formn of meristems (SM)
- interfascicular cambium
- cork cambium

- paranchyma cell divide to form callus under controlled lab condn during tissue culture

Re-Differentiation

- Again lose dividing capacity but cell mature to perform specific function

eg: • woody dicot plant

we have mentioned that the growth in plants is open, i.e., it can be indeterminate or determinate. Now, we may say that even differentiation in plants is open, because cells/tissues arising out of the same meristem have different structures at maturity. The final structure at maturity of a cell/tissue is also determined by the location of the cell within. For example, cells positioned away from root apical meristems differentiate as root-cap cells, while those pushed to the periphery mature as epidermis.

⑥ Plant Growth Regulator

Growth promotor

↓

cell division, cell enlargment, pattern form^{n}, seed form^{n} etc

→ · Auxin : indole compounds
· Gibberellins : Terpenes
· Cytokinins : Adenine derivative (N^{6}-FFA-Purine)
· ethylene (gas) : Ethephon

Growth inhibitor

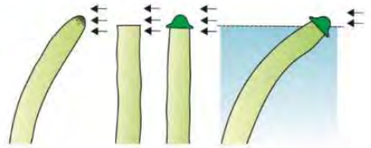
↓

· Respond to wound, stress
· Dormancy, Abscission

→ · Abscisic acid : carotenoids
· ethylene (gas)
↳ mainly

⑦ AUXIN

· Isolated by Fw·went from tip of oat colephiles
· Charles darwin & Frances darwin
↓
Observe that bending of canary grass towards unilateral light
↓
Phototropism



→ Introduce term Auxin (greek) → growth

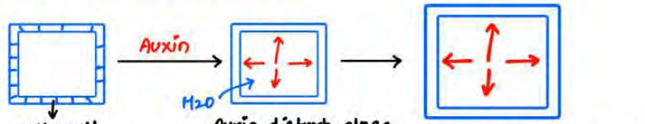
* Types of auxin

Natural auxin (isolated from plant)
- IAA
- IBA

Synthetic auxin
- 2-4 D
- NAA

} used in agriculture & Horticulture

* Mechanism of Auxin Action



cell wall (crosslinking of cellulosic fibre)

Auxin disturb close packing of fibre

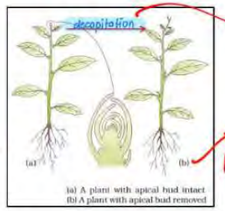
expension of plant cell (Auxeintic growth)

★ Functions of Auxin

V WAR in FF

- vascular cambium (xylem) differentiation & cell division
- weedicide/Herbicides : 2-4 D → kill dicot weed (do not affect monocot plant)
- Abscession (removal) → Stop abscession at early stage (younger plant part) → prevent early drop
  → promote abscession in older plant part
- Apical dominance → apical bud inhibit growth of lateral/axillary bud

* Removal of Apical dominance → Decapitation → growth of lateral bud ✓



(a) A plant with apical bud intact
(b) A plant with apical bud removed

- Tea plantations
- Hedge making

- Root initation after stem cutting → plant propagation
- Flowring in pineapples
- Fruit development
- parthanocarpy (Tomato)

Auxin synthesis
- Indole compound (Tryptophan) $\xrightarrow{Zn^{+2}}$ IAA
- Auxin synthesised in stem froot apices

(8) Gibberellic acid

- E. Kurosawa Report (1926)

Rice seedling —Fungal pathogen (Gibberella fujikuroi)→ Diseased (tall, sterile) → Bakane foolish seedling disease

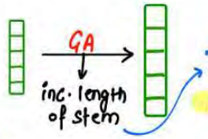
- There are more than 100 GA (GA_1, GA_2, GA_3 ...) (acidic)
  - (Fungi & Higher plants)
  - GA_3: • 1st discovered • most used (speed up malting process in brewing industry)
- produce wide range of physiological response
- Fruit growth → Grapes: (inc length of grapes stalks)
  → Apple: (elongation)
- GA synthesised in → young embryo, young root, leaf

★ Functions — Dr. SahaB

- Dormancy breaker
  - Seed fail to geminate even when ext. cond^n are favourable
- delay senescence
  - so that fruit can be left on tree longer
  - ∴ it extend marked period

Exception: Juvenile conifers —GA→ Promote Senescence (Maturity period fast) → early seed devept

- stem elongation in sugercane



GA → inc. length of stem → ∴ Suger content ↑ → inc. yield by 20 tonnes/acre

- Bolting ✓ (wasteful phenomenon)

→ Roseff habit plant — internode elongation → just prior to flowring

eg: Cabbage, beet

⑨ Cytokinins (specific effect on cytokinesis)

- Skoog & co-workers **develop** → tissue culture method (in tobacco plant)

Tobacco stem → internode (callus) → mass of undiff^{t} cell

- Auxin → ✗
- Auxin + nutrient medium → ✓ proliferate (growth retain)
  - vascular tissue extract
  - yeast extract
  - coconut milk/DNA

but fail to extract promoting substance

alternate approach

- collect Hearing fish sperm → extract DNA product → purine derivative → Adenine

modified

Natural cytokinin: Zeatin
- extracted from corn kernels & coconut milk
- cytokinesis ✓
- synthesised in: Rapid cell division region → Root apics, Shoot buds, young fruit, etc.

Kinetin (Synthetic) { capacity to induce cell division/cytokinesis }
- identified & named by Miller (1955)

★ Functions:

- produce New:
  - chloroplast
  - leaves
  - lateral bud
  - Adventitious shoot
- Delay leaf senescence
- overcome Apical dominance
- Nutrient metabolism ✓
- cytokinesis

DONKey

⑩ Ethylene ($C_2H_4 \rightarrow CH_2=CH_2$) → only gaseous PGR

- 1910, HH. cousins

Ripened orange + unripened banana → (Both Ripened)

Release volatile substance (later → ethylene)

- Growth promoter & Growth inhibitor (mainly)
- widely used PGR in agriculture

All: b/c it regulate many physiological process

- During Fruit Ripening → Respiration Rate ↑ → c/q Respiratory Climate

* Source of Ethylene → Ethephone (aq. soln)
- Readily absorbed & transport in plant
- Release ethylene slowly

- fruit Ripening fast (in tomato & apples)
- accelerate abscission

★ Functions DEAR Friends HASo

- Dormancy breaker in seed & bud (∴ initiate germination in peanut seed, potato tubers)
- Elongation of internode/petiole in deep water rice plant (∴ leaves/upper shoot remain above water)
- Abscession ✓, Senescence ✓
  - Abscession → in fruit & flowers (thinning: cotton, cherry, walnut)
  - (detachment)
- Root growth & Root hair formation (absorption surface ↑)
- Flowering & Synchronising in pineapples & mango
- Fruit Ripening (main function, highly effective)
- Sex determination in cucurbita family
  - promote female flower in cucumbers → ∴ increase yield/productivity in cucumbers
- Horizontal growth of seedling
- Apical Hook formation in dicot seedling
- Swelling of axis

(11) Abscisic Acid

- Three independent researches (1960) → 3 kinds of inhibitor → Inhibitor B, Abscission II, Dormin
  - later chemically identical → ABA

★ Functions MAD SI

- Metabolism inhibitor
- Abscession in leaf
- Antagonistic to GA
- Dormancy promoter [∴ it helps seed to withstand desiccation (tolerate dehydration)]
- Stomal closer
- Stress Hormone (B/C it increase the tolerance of plants to various kinds of stress)
- Inhibition of Germination

* Seed → Development, maturation, Dormancy

Question No. - 01

The ultimate electron acceptor of respiration in an aerobic organisms is:

A Cytochrome

B Oxygen

C Hydrogen

D Glucose

Question No. - 02

Phosphorylation of glucose during glycolysis is catalysed by

addition of phosphate

A Phosphoglucomutase

B Phosphoglucoisomerase

C Hexokinase ✓

D Phosphorylase

Question No. - 03

Pyruvic acid, the key product of glycolysis can have many metabolic fates. Under aerobic condition it forms

A Lactic acid

B $CO_2 + H_2O$

C Acetyl CoA + CO_2 – link rxn

D Ethanol + CO_2

Question No. - 04

Electron Transport System (ETS) is located in mitochondrial

A Outer membrane

B Inter membrane space

C Inner membrane

D Matrix

Question No. - 05

Which of the following exhibits the highest rate of respiration?

A Growing shoot apex

B Germinating seed

C Root tip

D Leaf bud

Question No. - 06

Mitochondria are called powerhouses of the cell. Which of the following observations support this statement?

A Mitochondria synthesise ATP

B Mitochondria have a double membrane

C The enzymes of the Krebs cycle are found in mitochondria.

D Mitochondria are found in almost all plants and animal cells.

Question No. - 07

The end product of oxidative phosphorylation is

A NADH

B Oxygen

C ADP

D $ATP+H_2O$

Question No. - 08

Match the following and choose the correct option from those given below:

Column I	Column II
A. Molecular oxygen ii	i. α - Ketoglutaric acid
B. Electron acceptor iii	ii. hydrogen acceptor
C. Pyruvate dehydrogenase iv	iii. cytochrome C
D. Decarboxylation i	iv. acetyl Co A

(A) A-ii, B-iii, C-iv, D-i

(B) A-iii, B-iv, C-ii, D-i

(C) A-ii, B-i, C-iii, D-iv

(D) A-iv, B-iii, C-i, D-ii

Question No. - 09

Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R):

Assertion (A): ATP is used at two steps in glycolysis.

Reason (R): First ATP is used in converting glucose into glocose-6-phosphate and second ATP is used in conversion of fructose-6 phosphate into fructose-1-6-diphoshate.

In the light of the above statements, choose the correct answer from the options given below :

[NEET – 2023]

A (A) is false but (R) is true

B Both (A) and (R) are true and (R) is the correct explanation of (A)

C Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

D (A) is true but (R) is false

Question No. - 10

Match List I with List - II

List – I		List – II	
A.	Oxidative decarboxylation	I.	Citrate synthase
B.	Glycolysis	II.	Pyruvate dehydrogenase
C.	Oxidative phosphorylation	III.	Electron transport system
D.	Tricarboxylic acid cycle	IV.	EMP Pathway

Choose the correct answer from the options given below : [NEET – 2023]

	A	B	C	D
A	II	IV	III	I
C	II	IV	I	III

	A	B	C	D
B	III	IV	II	I
D	III	I	II	IV

Question No. - 11

How many times decarboxylation occurs during each TCA cycle? [NEET – 2023]

A Thrice

B Many

C Once

D Twice

Question No. - 12

Fatty acids are connected with the respiratory pathway through: [NEET – 2023]

A Acetyl CoA ✓

B α - Ketoglutaric acid

C Dihydroxy acetone phosphate – glycerol

D Pyruvic acid

Question No. - 13

What amount of energy is released from glucose during lactic acid fermentation?

[NEET – 2022]

A Less than 7%

B Approximately 15%

C More than 18%

D About 10%

Question No. - 14

What is the net gain of ATP when each molecule of glucose is converted to two molecules of pyruvic acid?

[NEET – 2022]

A Eight

B Four

C Six

D Two

Question No. - 15

Match List I with List - II

List – I		List – II	
A.	ETS Complex-I	I.	Cyt bc1
B.	ETS complex-II	II.	Cyt a, a3 and 2 copper centres
C.	ETS complex-III	III.	NADH dehydrogenase
D.	ETS complex-IV	IV.	Ubiquinone and $FADH_2$ dehydrogenase

Choose the correct answer from the options given below : [NEET – 2022]

	A	B	C	D
A	II	I	IV	III
C	III	II	I	IV

	A	B	C	D
B	IV	III	II	I
D	III	IV	I	II

Question No. - 16

Identify the cytochrome which acts as a mobile carrier for the transfer of electrons between complex III and IV? [NEET – 2022]

A Cytochrome a

B Cytochrome a_3

C Cytochrome b c_1

D Cytochrome c

Question No. - 17

The number of time(s) decarboxylation of isocitrate occurs during single TCA cycle is :

[NEET – 2022]

A One

B Two

C Three

D Four

Question No. - 18

The 5-C compound formed during TCA cycle is : [NEET – 2022]

A α-ketoglutaric acid

B Oxalo succinic acid

C Succinic acid

D Fumaric acid

Question No. - 19

Which of the following statements is incorrect? [NEET – 2021]

A ATP is synthesized through complex V

B Oxidation-reduction reactions produce a proton gradient in respiration

C During aerobic respiration, the role of oxygen is limited to the terminal stage

D In ETC (Electron Transport Chain), one molecule of NADH+H gives rise to 2 ATP molecules, and one FADH molecules

Question No. - 20

The number of substrate level of phosphorylations in one turn of citric acid cycle is:

[NEET – 2020]

GTP ✓.

A One ✓

B Two

C Three

D Four

Question No. - 21

Pyruvate dehydrogenase activity during aerobic respiration requires:

[NEET – 2020]

Link rxn
pyruvate ⟶ Acetyl coA

A Calcium

B Iron

C Cobalt

D Magnesium

Question No. - 22

Conversion of glucose to glucose-6-phosphate, the first irreversible reaction of glycolysis, is catalyzed by: [NEET – 2020]

A Phosphofructokinase

B Aldolase

C Hexokinase

D Enolase

Question No. - 23

Respiratory Quotient (RQ) value of tripalmitin is: [NEET – 2019]

A 0.09

B 0.9

C 0.7

D 0.007

Question No. - 24

Which of the following statements regarding mitochondria is incorrect?

[NEET – 2019]

A Mitochondrial matrix contains single circular DNA molecule and ribosomes.

B Outer membrane is permeable to monomers of carbohydrates, fats, and proteins.

C Enzymes of electron transport are embedded in the outer membrane.

D Inner membrane is convoluted with infoldings.

Question No. - 25

Where is the respiratory electron transport system (ETS) located in plants?

[NEET – 2019]

A Mitochondrial matrix

B Outer mitochondrial membrane

C Inner mitochondrial membrane

D Intermembrane space

Question No. – 26

What is the role of NAD^+ in cellular respiration? [NEET – 2018]

A. It functions as an enzyme.

B. It functions as an electron carrier

C. It is a nucleotide source for ATP synthesis

D. It is the final electron acceptor for anaerobic respiration

$H_2 = 2e^- + 2H^+$

ADP

Question No. - 27

Which of these statements is incorrect? [NEET – 2018]

A Enzymes of the TCA cycle are present in the mitochondrial matrix

B Glycolysis occurs in the cytosol

C Glycolysis operates as long as it is supplied with NAD that can pick up hydrogen atoms

D Oxidative phosphorylation takes place in the outer mitochondrial membrane

Question No. - 28

Which statement is wrong for Krebs' cycle? [NEET – 2017]

A. There is one point in the cycle where FAD^+ is reduced to $FADH_2$

B. During conversion of succinyl CoA to succinic acid, a molecule of GTP is synthesized.

C. The cycle starts with condensation of acetyl group (acetyl CoA) with pyruvic acid to yield citric acid.

D. There are three points in the cycle where NAD is reduced to $NADH + H^+$

Question No. - 29

Which of the following biomolecules is common to respiration-mediated breakdown of fats, carbohydrates and proteins? [NEET 2016]

A Glucose-6-phosphate

B Fructose 1, 6-bisphosphate

C Pyruvic acid

D Acetyl Co-A

Question No. - 30

Oxidative phosphorylation is [NEET – 2016]

A formation of ATP by transfer of phosphate group from a substrate to ADP

B oxidation of phosphate group in ATP

C addition of phosphate group to ATP

D formation of ATP by energy released from electrons removed during substrate oxidation

Question No. - 01

Ethylene is used for

A Retarding ripening of tomatoes

B Hastening of ripening of fruits

C Slowing down ripening of apples

D Both b and c

Question No. - 02

Coconut water contains

A ABA

B Auxin

C Cytokinin

D Gibberellin

Question No. - 03

The affect of apical dominance can be overcome by which of the following hormone:

A IAA

B Ethylene

C Gibberellin

D Cytokinin

Question No. - 04

Match the following

A. IAA	(i) Herring sperm DNA
B. ABA	(ii) Bolting
C. Ethylene	(iii) Stomatal closure
D. GA	(iv) Weed-free lawns
E. Cytokinins	(v) Ripening of fruits

A. A – iv, B – iii, C – v, D – ii, E – i

B. A – v, B – iii, C – iv, D – ii, E – i

C. A – iv, B – i, C – iv, D – iii, E – ii

D. A – v, B – iii, C – ii, D – i, E - iv

Question No. - 05

Apples are generally wrapped in waxed paper to

A Prevent sunlight for changing its colour

B Prevent aerobic respiration by checking the entry of O_2.

C Prevent ethylene formation due to injury

D Make the apples look attractive

Question No. - 06

Growth can be measured in various ways. Which of these can be used as parameters to measure growth

A Increase in cell number

B Increase in cell size

C Increase in length and weight

D All the above

Question No. - 07

The term synergistic action of hormones refers to

A When two hormones act together but bring about opposite effects.

B When two hormones act together and contribute to the same function.

C When one hormone affects more than one function.

D When many hormones bring about any one function.

Question No. - 08

Plasticity in plant growth means that

A Plant roots are extensible

B Plant development is dependent on the environment

C Stems can extend

D None of the above

Question No. - 09

To increase sugar production in sugarcanes, they are sprayed with

A IAA

B Cytokinin

C Gibberellin

D Ethylene

Question No. - 10

ABA acts antagonistic to

A Ethylene

B Cytokinin

C Gibberlic acid

D IAA

Question No. - 13

Growth can be defined as an ..... increase in size of an organ (or) its parts (or) excess of an individual cell.

A Irreversible permanent

B Reversible temporary

C Irreversible temporary

D Reversible permanent

Question No. - 14

Arithmetic growth is mathematically expressed as

A $L_0 = L_t + rt$

B $L_t = L_0 + rt$ ✓

C $L_t = L_t + rt$

D $w_1 = w_0 e^{rt}$ - geometric growth

Question No. - 15

Plants follow different pathways in response to environment or phases of life to form different kinds of structures. This ability is called

A Competence

B Totipotency

C Plasticity

D Capillarity

Question No. - 16

Growth is maximum in zone of

A Cell elongation

B Cell differentiation

C Cell maturation

D All of these

Question No. - 17

Factors which influence growth are

A Nutrients

B Light, Temperature

C Water, Oxygen

D All of these

Question No. - 18

The hormone responsible for apical dominance is

A IAA

B GA

C ABA

D Florigen

Question No. - 19

Coconut milk contains

A ABA

B Auxin

C Cytokinin

D GA

Question No. - 20

To increase sugar production in sugarcane, they are sprayed with

A IAA

B Cytokinins

C Gibberellic acid

D Ethylene

Question No. - 23

Which of the following growth regulator is known as stress hormone ?

A Abscisic acid

B Ethylene

C GA_3

D Indole acetic acid

Question No. - 24

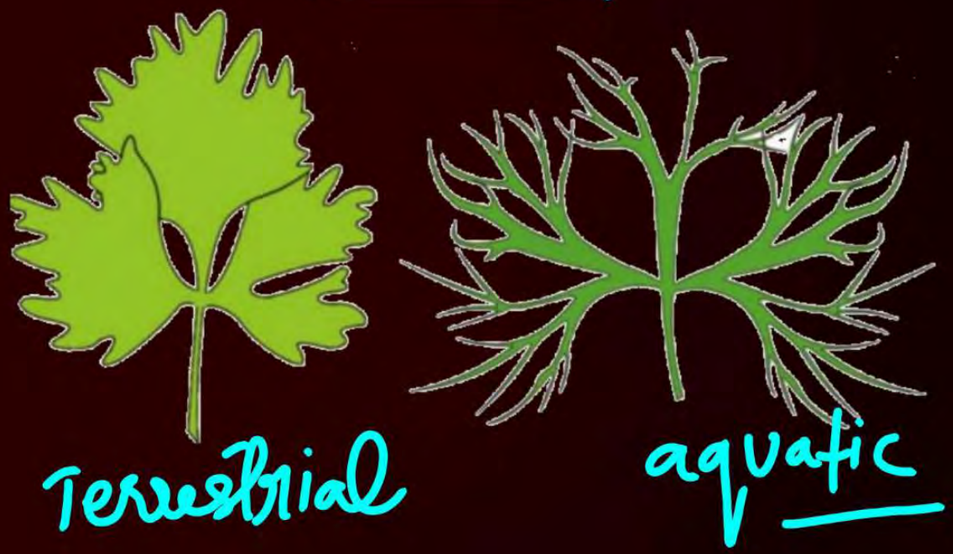
Which of the given condition is exhibited by the diagrams given below?

A Developmental heterophylly

B Environmental heterophylly

C Heteroblastic development

D More than one option is correct



Question No. - 25

Cytokinins and auxins are antagonistic to each other w.r.t.

A Cell division

B Apical dominance

C Internode elongation

D Delay in senescence

Question No. - 26

Parenchymatous cell that are made to divide under controlled laboratory conditions during plant tissue culture are

A Differentiated cells

B Dedifferentiated cells

C Undifferentiated cells

D Redifferentiated cells

parenchyma 'dediff' → meristem

meristem 'diff' → parenchyma

Question No. - 27

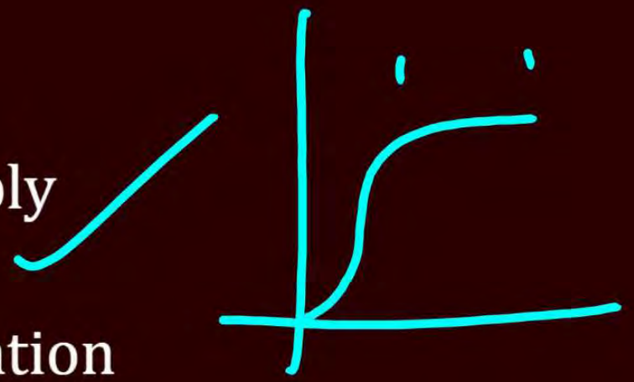
In sigmoid growth curve, the exponential phase slows down leading to a stationary phase due to

A Toxic effect of some plant hormones

B Genetic nature

C Limited nutrient supply

D Absence of differentiation



Question No. - 29

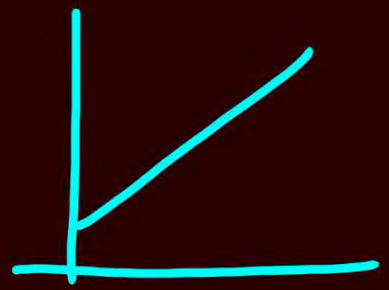
Typical growth curve in plants is

A Linear

B Stair-steps shaped

C Parabolic

D Sigmoid



Question No. - 31

Which of the following plant growth regulators is responsible for 'respiratory climatic' ?

Rate of respiration ↑→ during ripening

A Auxin

B Ethylene ✓

C ABA

D Cytokinin

Question No. - 33

Measurement and the comparision of total growth per unit time is called:

A Absolute growth rate

B Relative growth rate

C Geomatric growth

D Arithmetic growth

Question No. - 34

Phototropism is due to the hormone

A IAA

B GA

C 24D

D Cytokinin

Question No. - 35

Which one of the following hormone is concerned chiefly with root initiation?

A IBA

B GA_3

C ABA

D Kinetin

Question No. - 36

Which of the following induces femaleness in plants?

A Ethylene

B Ethanol

C ABA

D Gibberellin

Question No. - 37

Which of the following is weed killer?

A 2, 4–D

B NAA

C GA

D ABA

Question No. - 38

Bolting hormone is:-

A Auxin

B Gibberellin

C ABA

D Ethylene

Question No. - 39

Assertion: Auxin prevent fruit and leaf drop at early stage
Reason: Auxin promote abscission of older mature leaves & fruits
Choose the appropriate option –

A Assertion is correct and Reason is incorrect

B Assertion is incorrect and Reason is correct

C Both Assertion & Reason are correct

D Both Assertion & Reason are incorrect

Question No. - 40

Ethylene initiates –

A Flowering in pineapple

B Flowering in mango

C Synchronizing fruit-set in pineapple

D All of these

Question No. - 41

In most situation, ABA acts as an antagonist to-

opposite

A Auxin

B GA

C Cytokinin

D Ethylene

Question No. - 42

Read the following statements regarding cytokinin –

(i) Kinetin occurs naturally in plants

(ii) Kinetin was discovered from coconut milk

(iii) Zeatin does not occur naturally in plants

(iv) Zeatin was isolated from human DNA

How many of the statements are incorrect –

A 1

B 2

C 3

D 4

Thank You