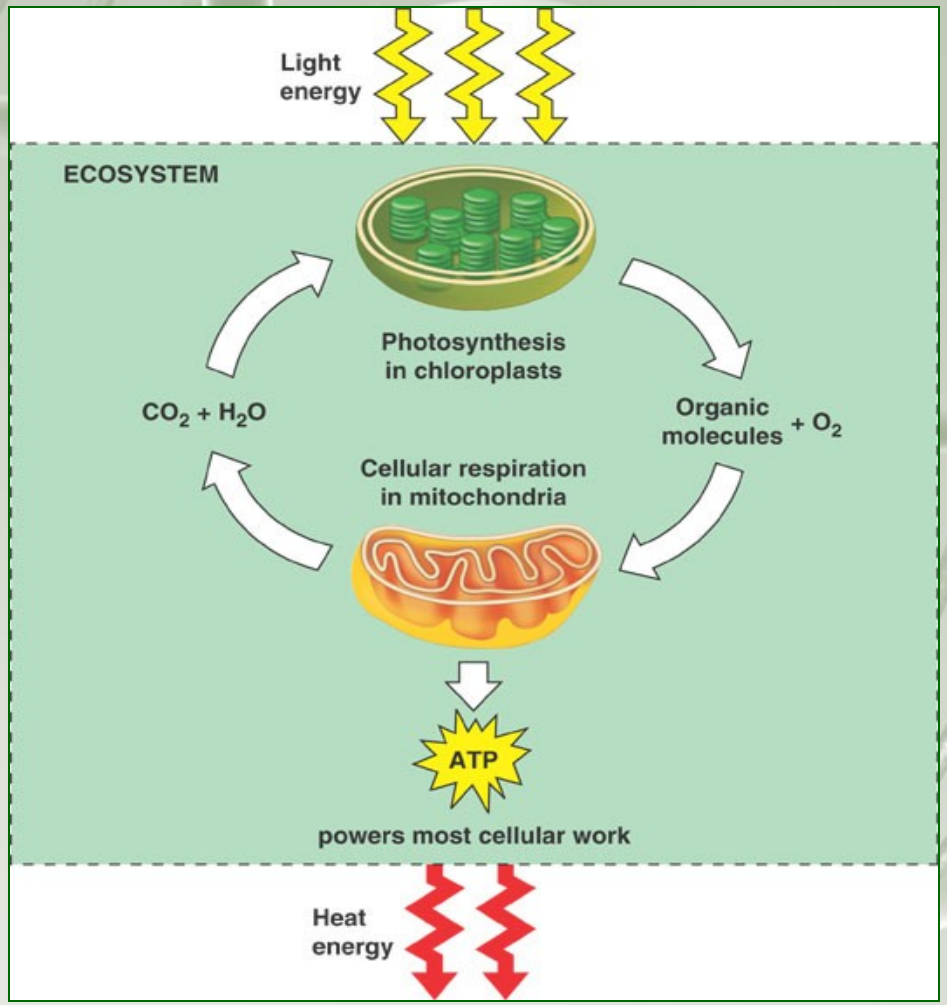
BIOLOGY

BIOENERGETICS AND GROWTH IN PLANTS

BIOLOGY

What is Bioenergetics?

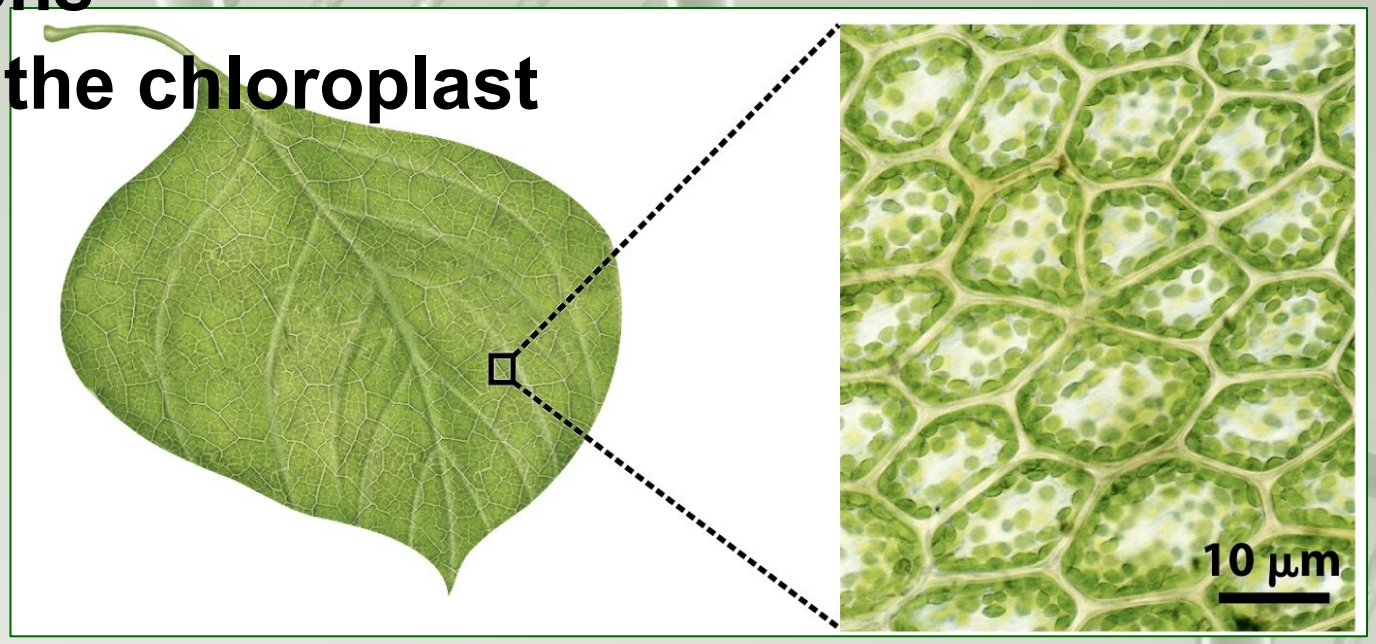


What is photosynthesis?

- Process that manufactures food or starch
- Reverse of oxidative respiration:

$CO_2 + 2H_2O + \text{light energy} \rightarrow (CH_2O)_n + H_2O + O_2$

  - Autotrophs
- Occurs in the chloroplast



The overall gist of photosynthesis…

- 2 sets of reactions
  - -Light dependent
    - -Create O_2 from H_2O, ATP and NADPH produced
  - - Light independent
    - - Create glucose using CO_2
- Occur in different regions of chloroplast

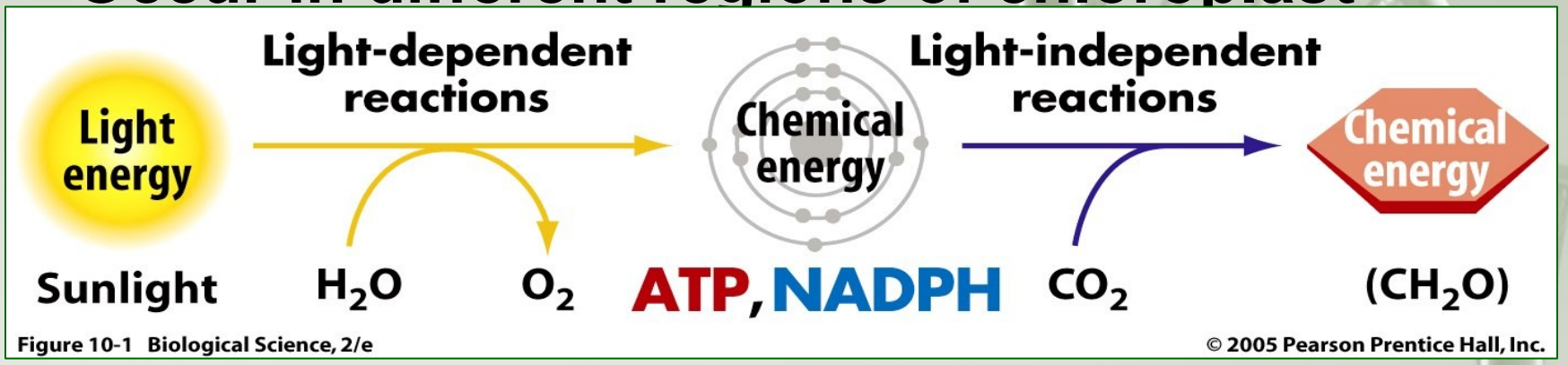


Figure 10-1 Biological Science, 2/e

What is a chloroplast?

- **Organelle which captures photons of light from the sun**
  - **Converts $H_2O + CO_2 \rightarrow$ glucose**
  - **Reactions occur in thylakoids of chloroplast**

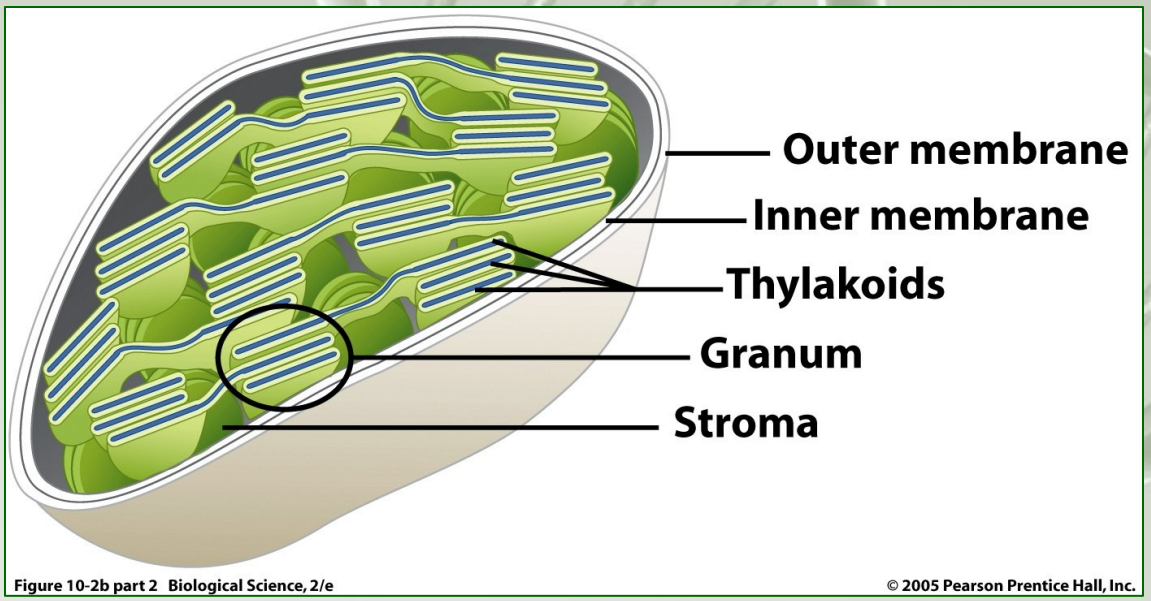
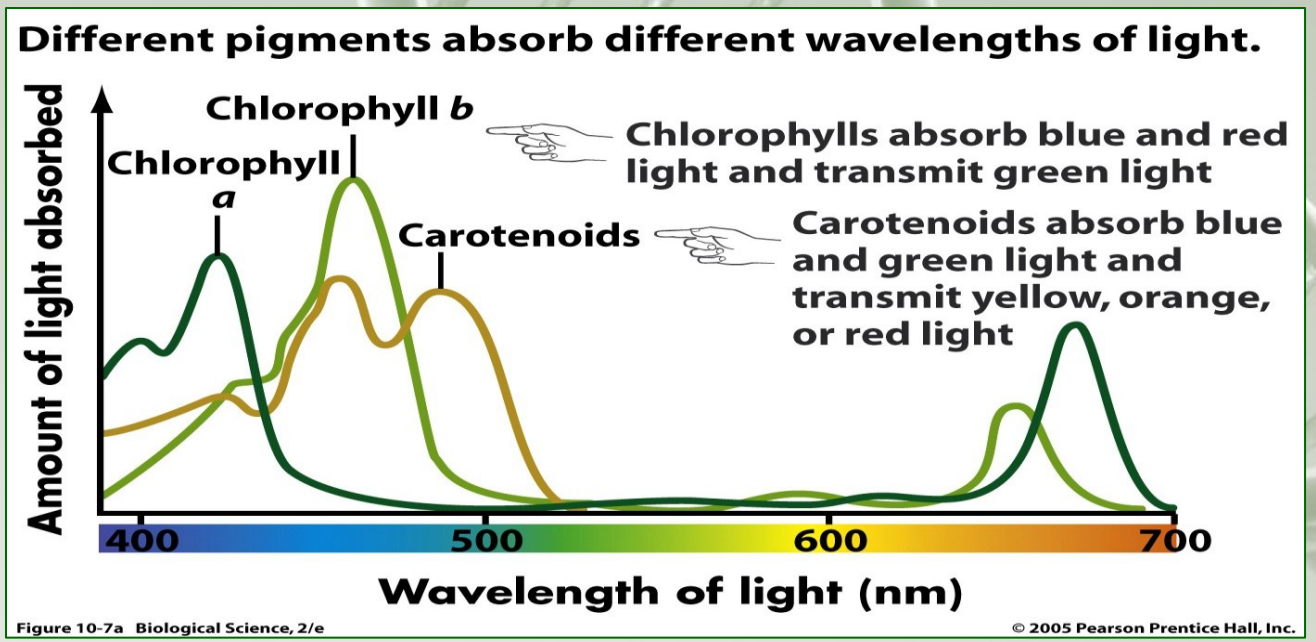


Figure 10-2b part 2 Biological Science, 2/e

More about chlorophyll……

- **Absorbs photons of light**
  - **Packet of light containing energy**
  - **Wave or particle**



What happens when pigments absorb photons?

- **Increases energy state of electron**

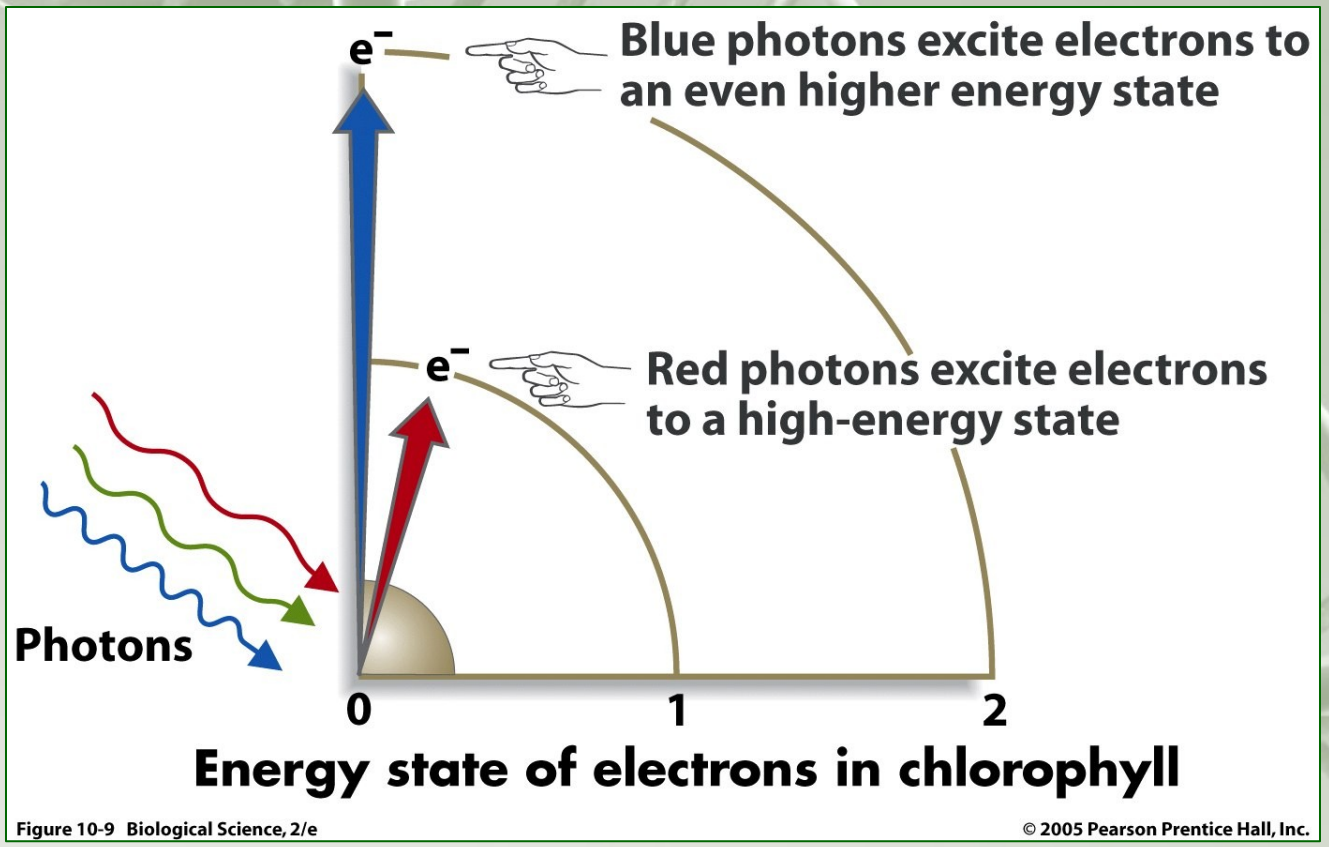
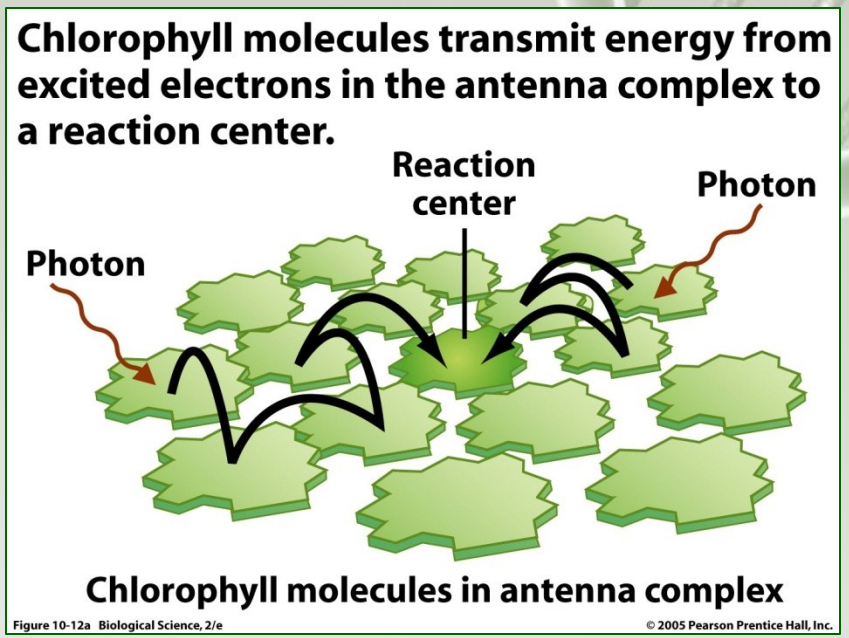
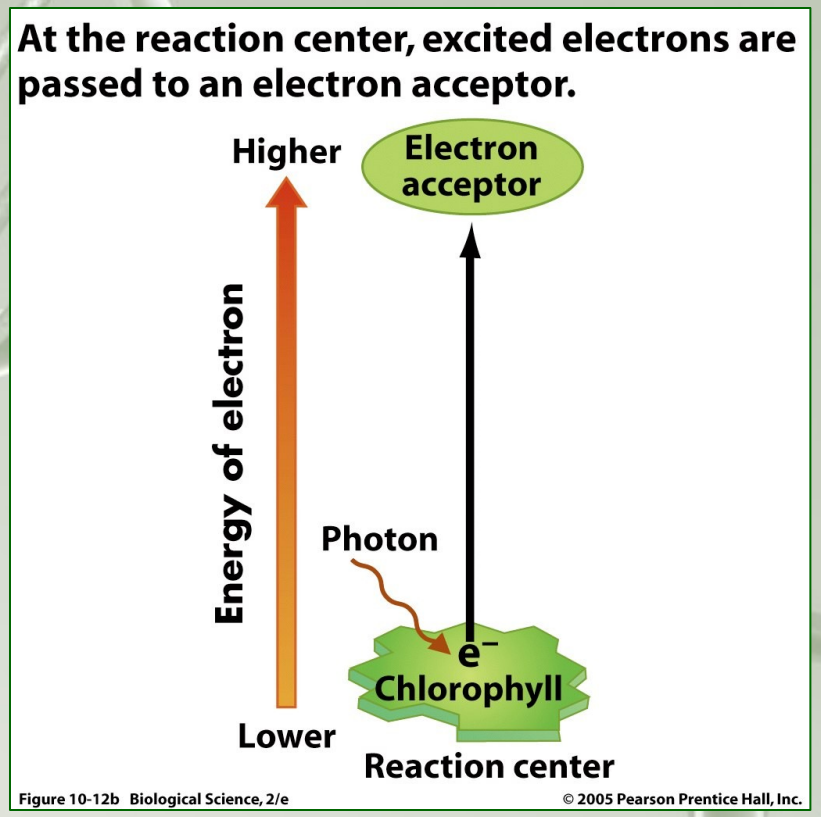


Figure 10-9 Biological Science, 2/e

How are chlorophyll molecules organized?

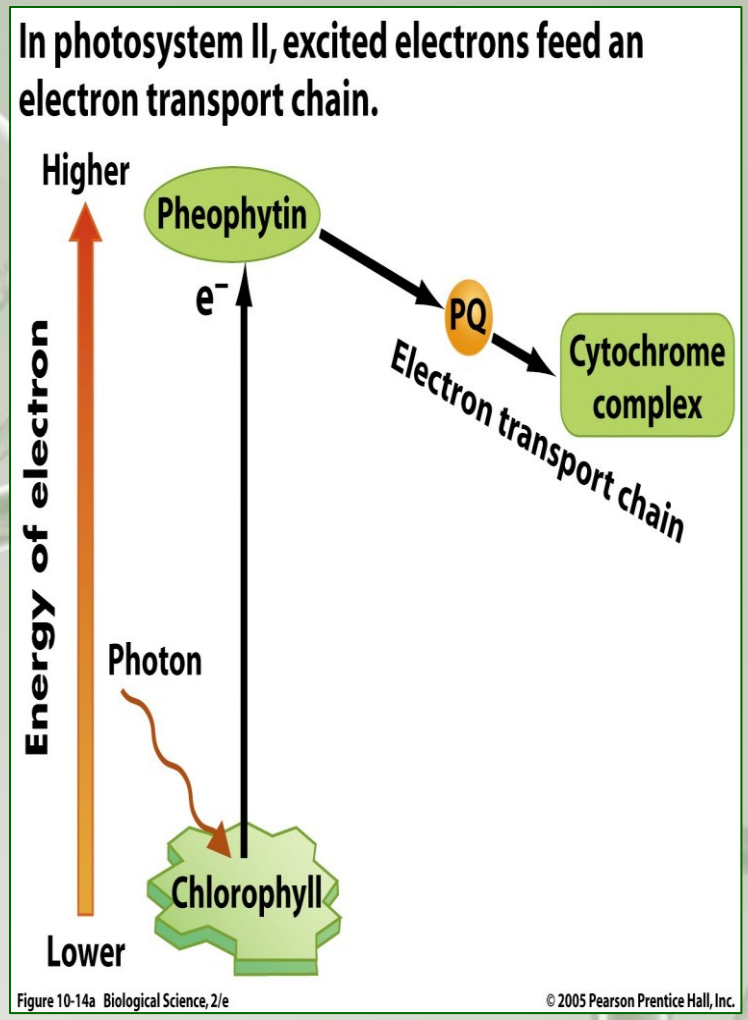
- 200-300 chlorophyll molecules per thylakoid
- Grouped into complexes
  - Antenna complex
  - Reaction center





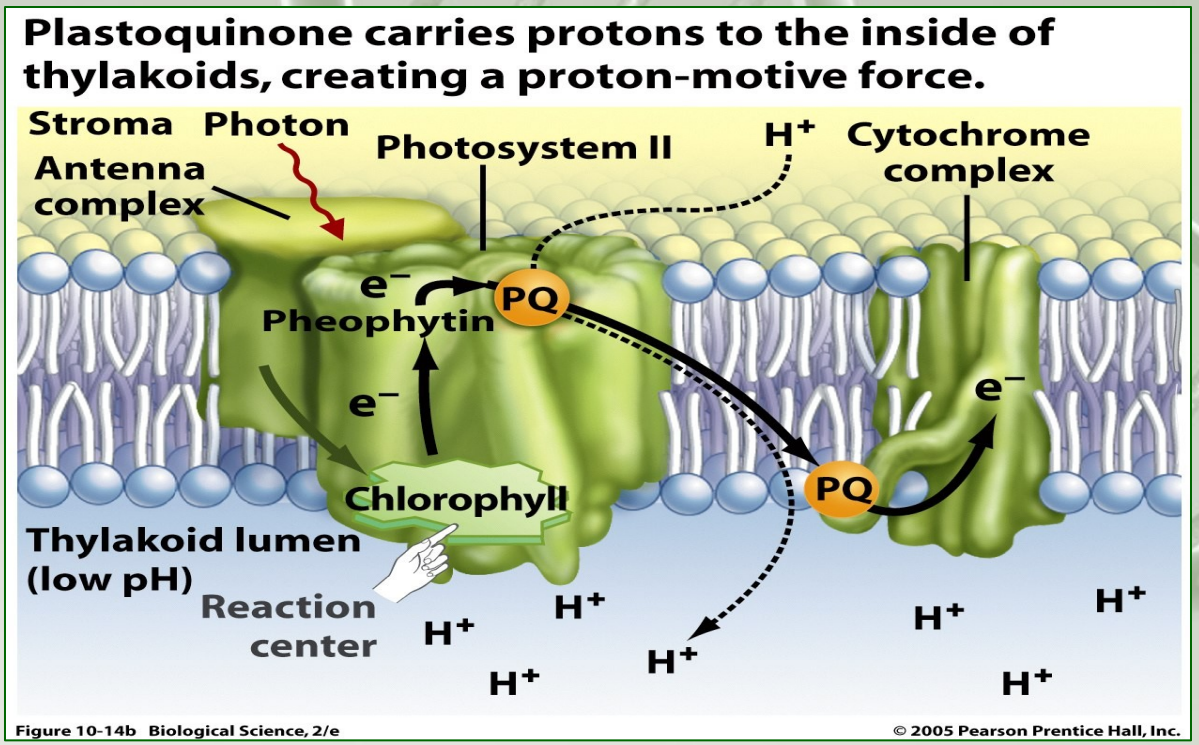
How does photosystem II (P680) work?

- Plastoquinone (PQ)
- Moves electrons
- Also moves H^+(protons) across thylakoid membrane
- Pheophytin
  - Accepts electron
  - Moves it to an ETC



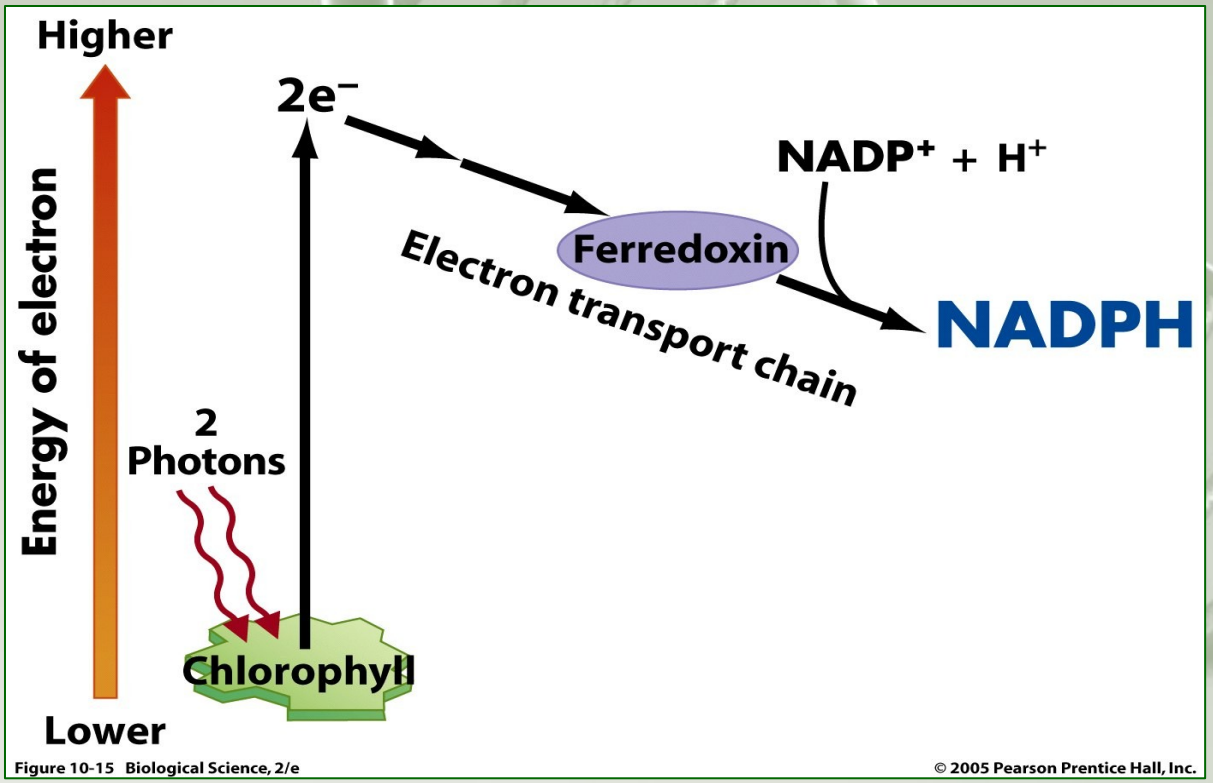
How do the protons help make ATP?

- Proton-motive force
- Photo- phosphorylation
- In mitochondria oxidative phosphorylation



How does photosystem I (P700) work?

- Makes NADPH from NAD+
- Uses ferrodoxin to shuttle electrons and photon



Non-cyclic photophosphorylation ….

- Called the Z scheme
- PC (plastocyanin) moves electron from photosystem II to I

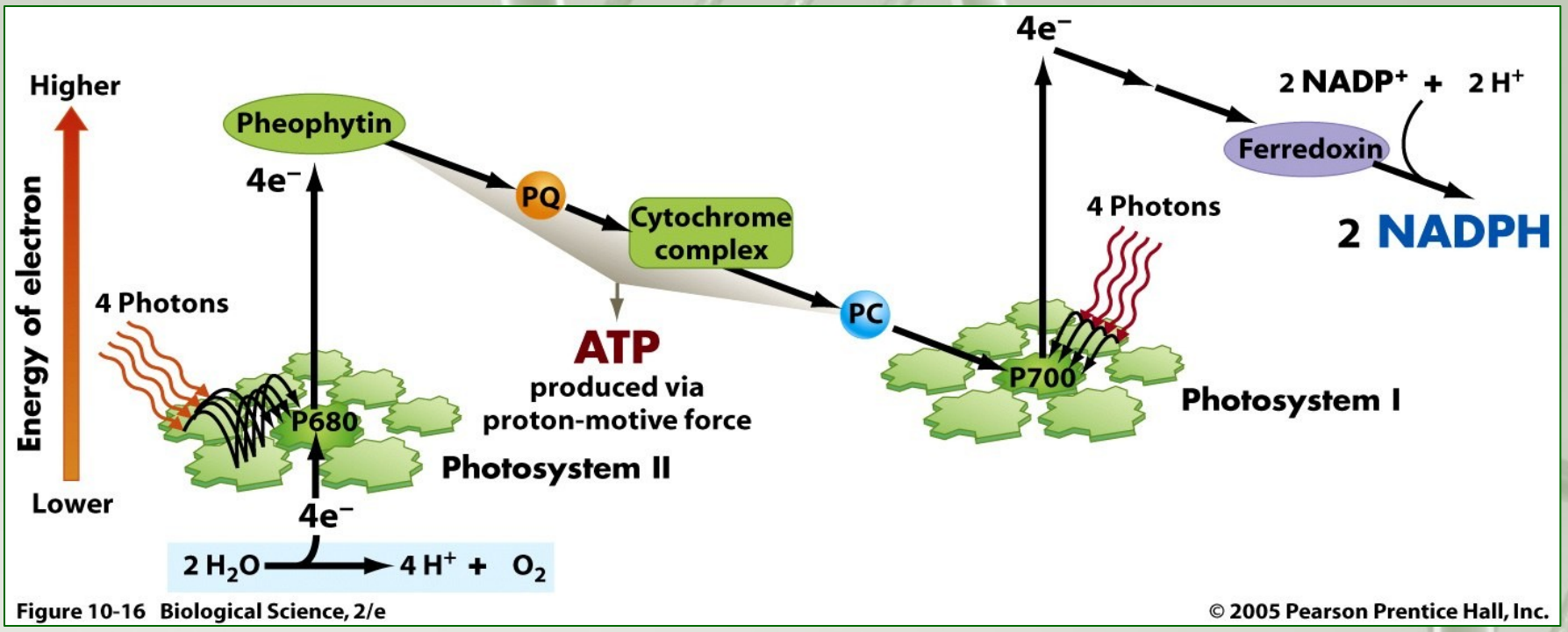


Figure 10-16 Biological Science, 2/e

What is cyclic photophosphorylation?

- **Photosystem I sends electrons to ETC**
  - **Adds to ATP production**

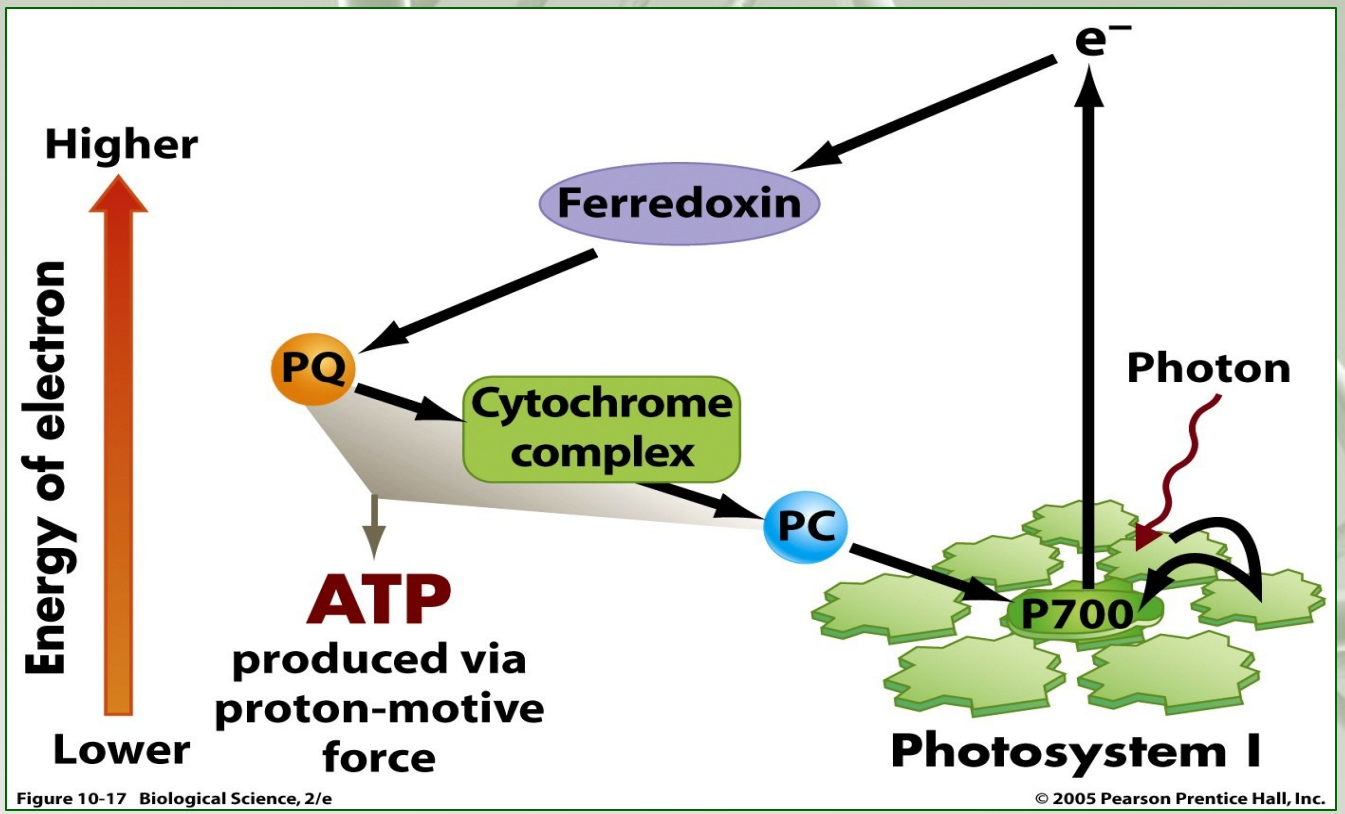
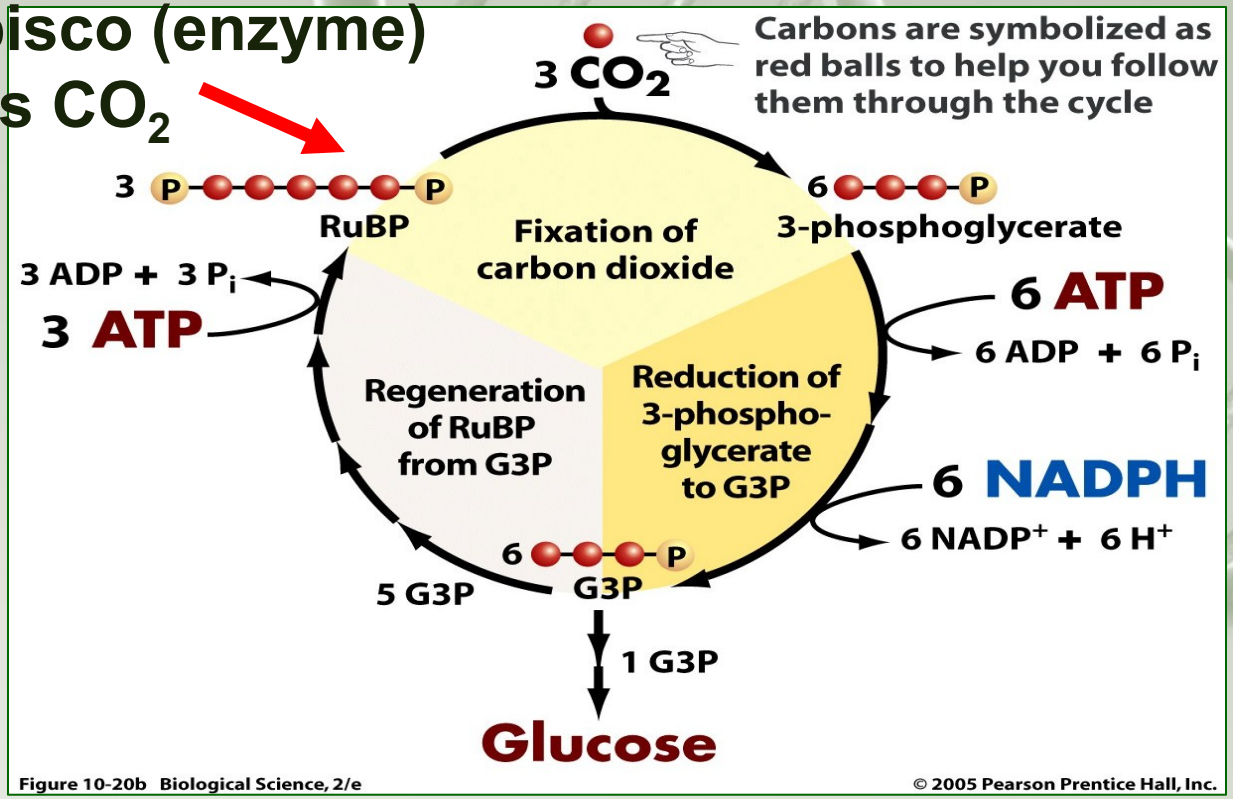


Figure 10-17 Biological Science, 2/e

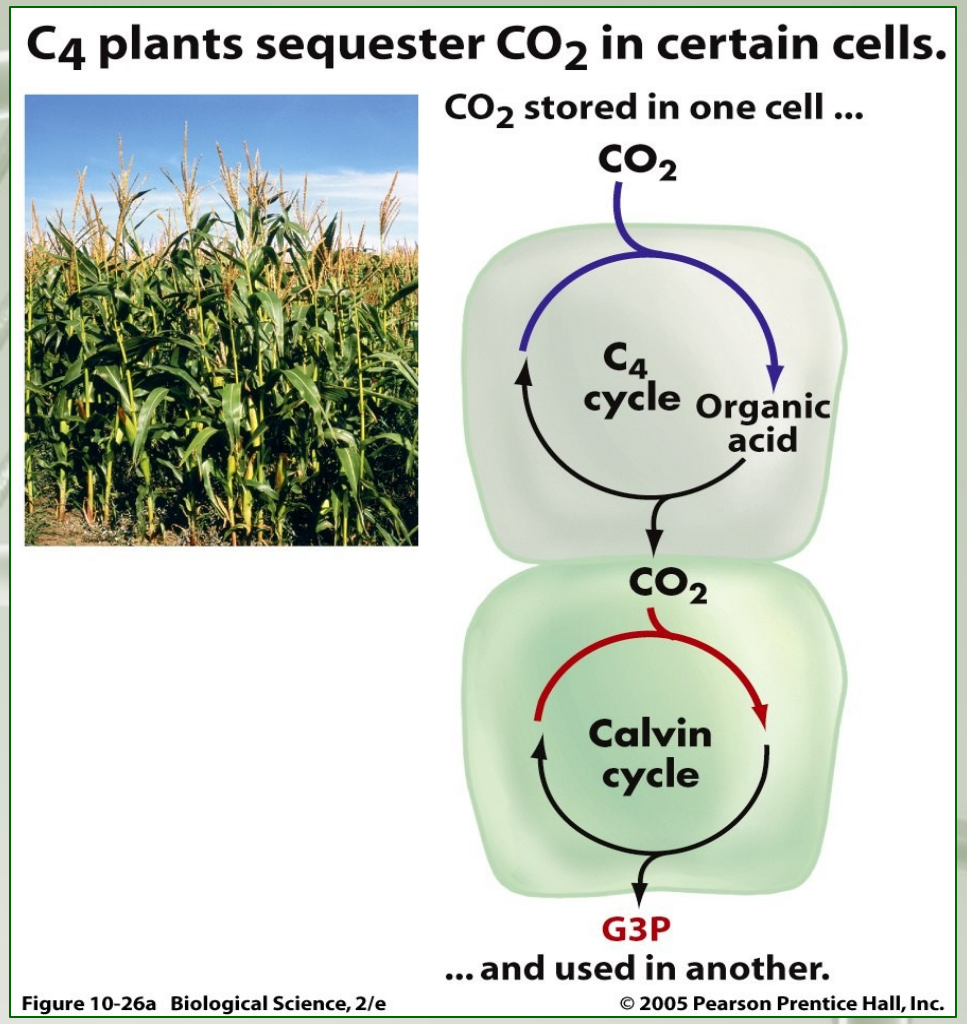
What happens during dark reactions?

- Fixation, reduction and regeneration
- Occurs in chloroplast stroma
- ATP and NADPH are utilised.
  - Rubisco (enzyme)
  - Uses CO_2



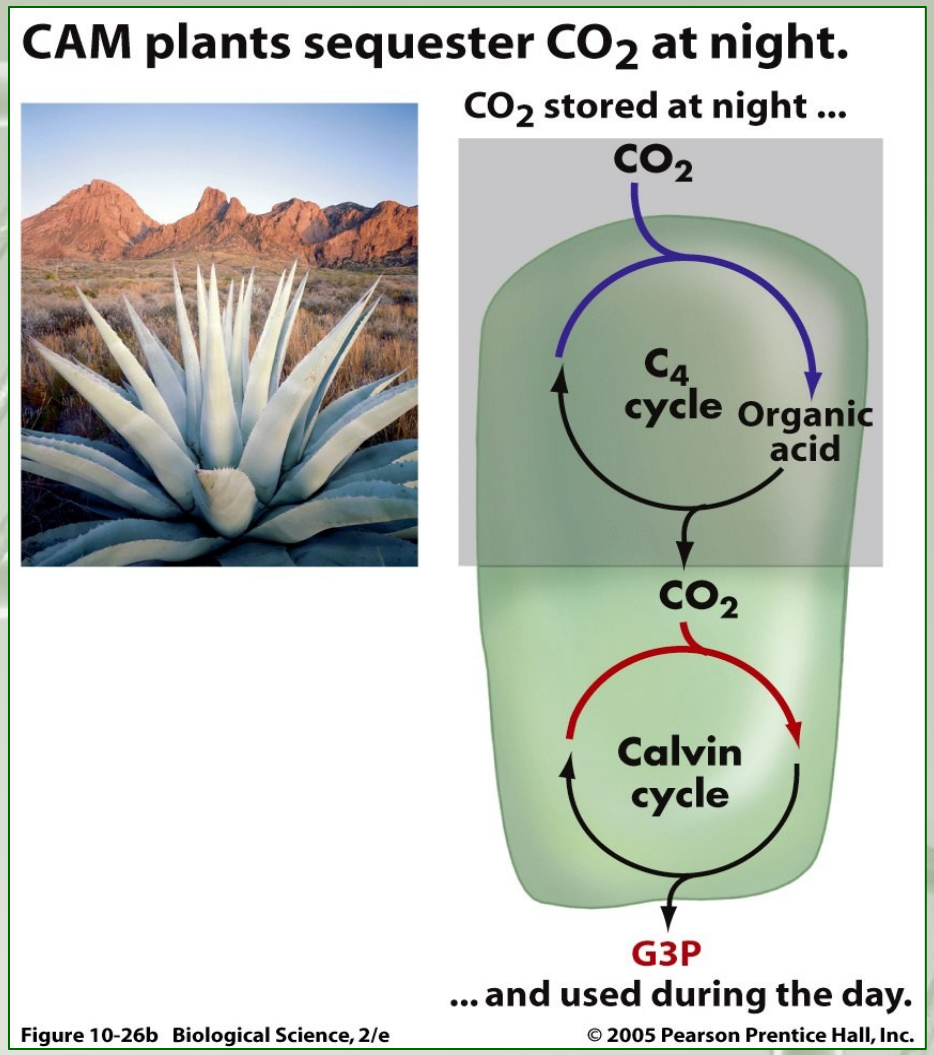
What happens in C4 plants?

- Hatch –Slack pathway
- Kranz anatomy
- 4-C organic acids release CO_2 to rubisco
- PEP is the primary acceptor



What happens in CAM plants?

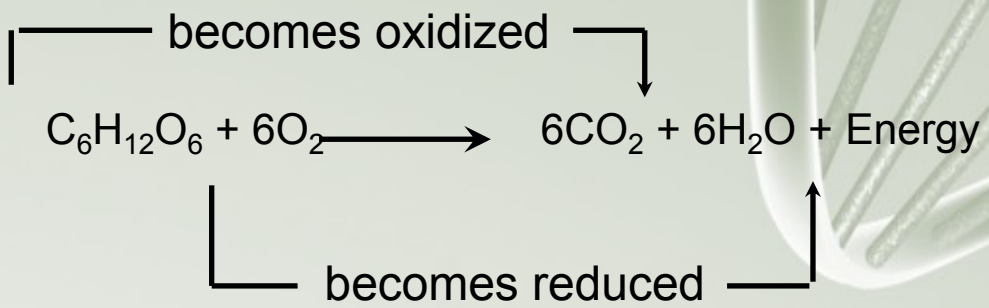
- Stomata opens during night.
- CO_2 accumulates at night.
- CO_2 fixes as malic acid.



Cellular respiration …..

- Is the most prevalent and efficient catabolic pathway
- Consumes oxygen and organic molecules such as glucose
- Yields ATP

- During cellular respiration
  - Glucose is oxidized and oxygen is reduced



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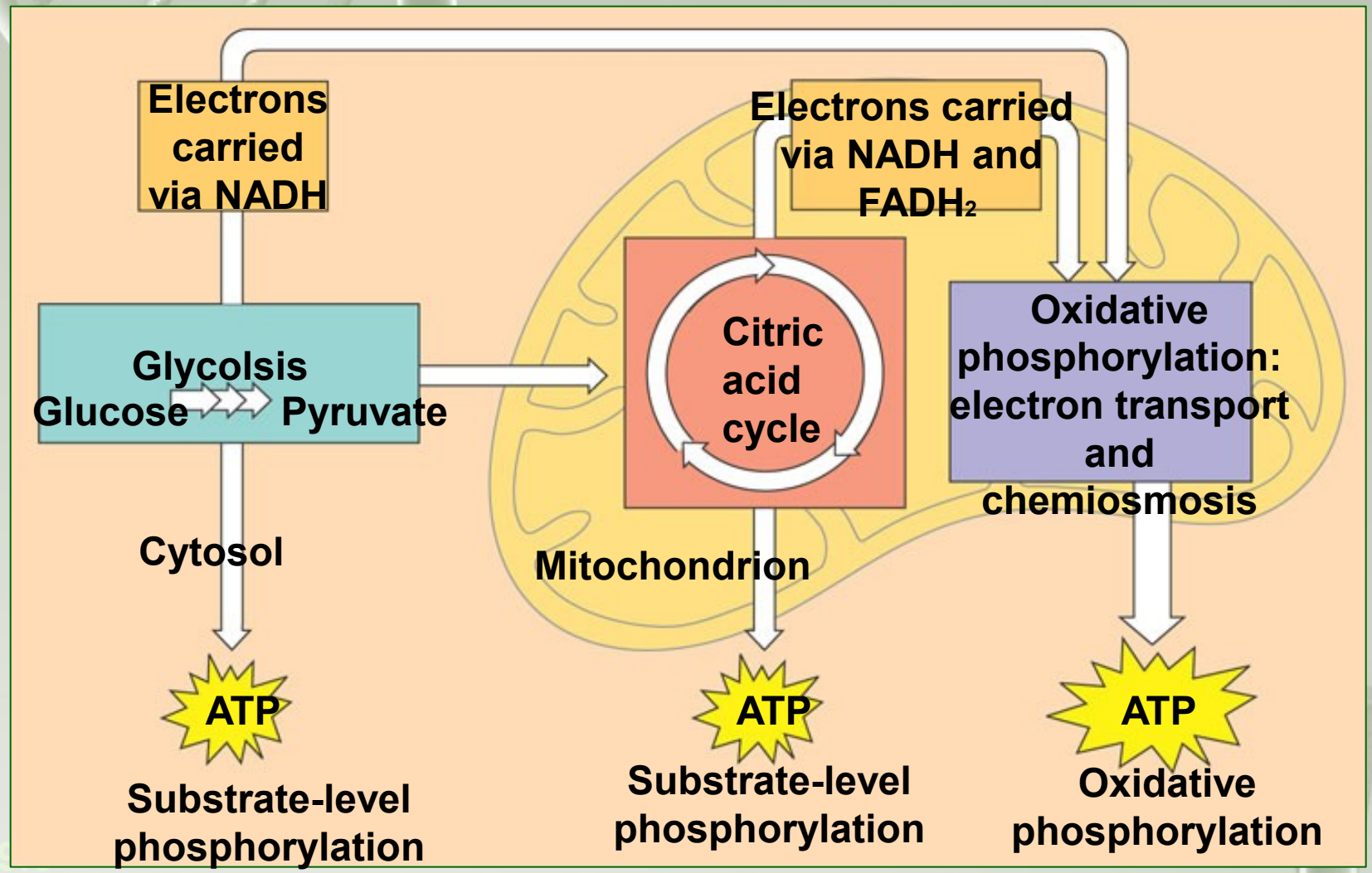
An overview of cellular respiration ….



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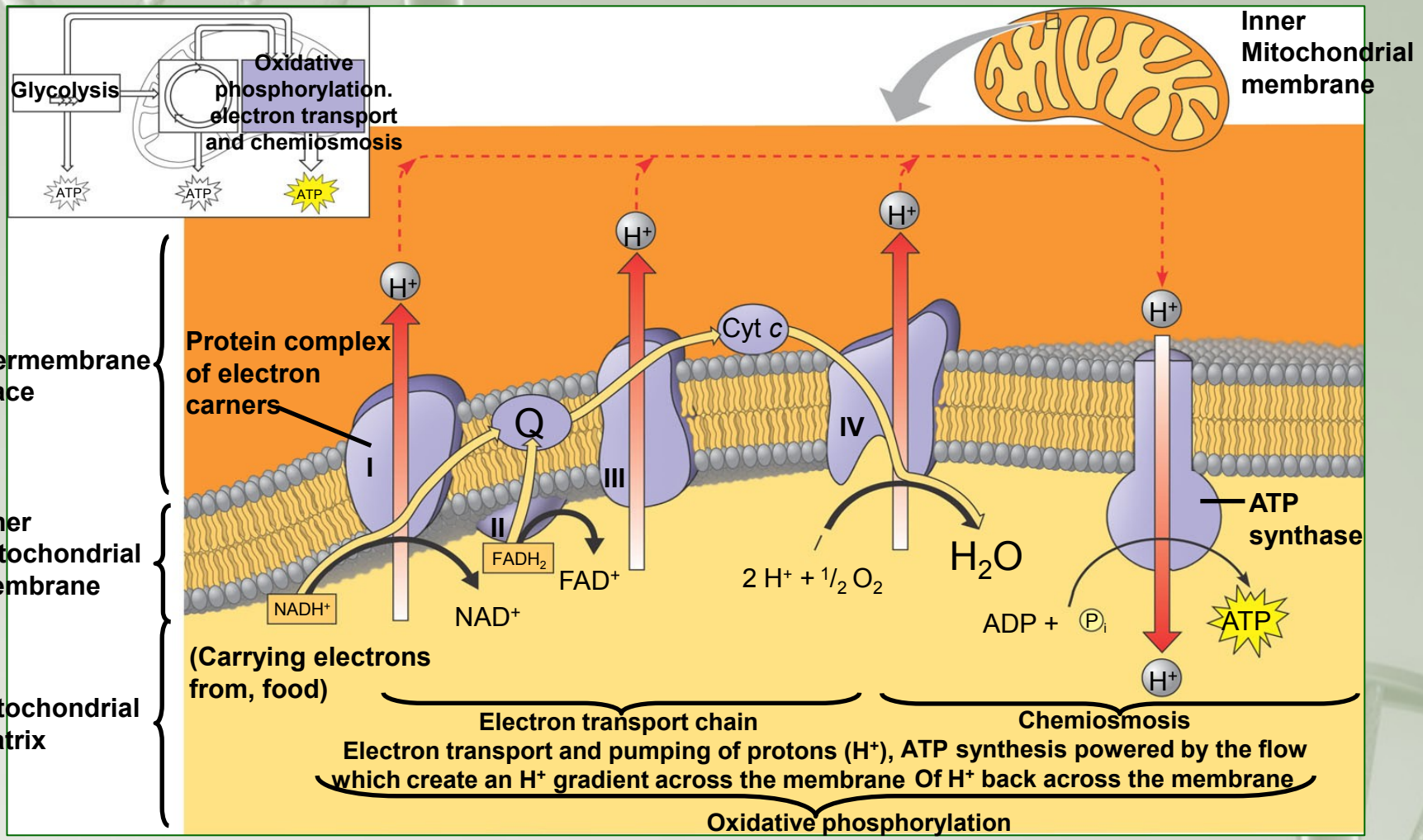
Chemiosmosis & the Electron transport chain



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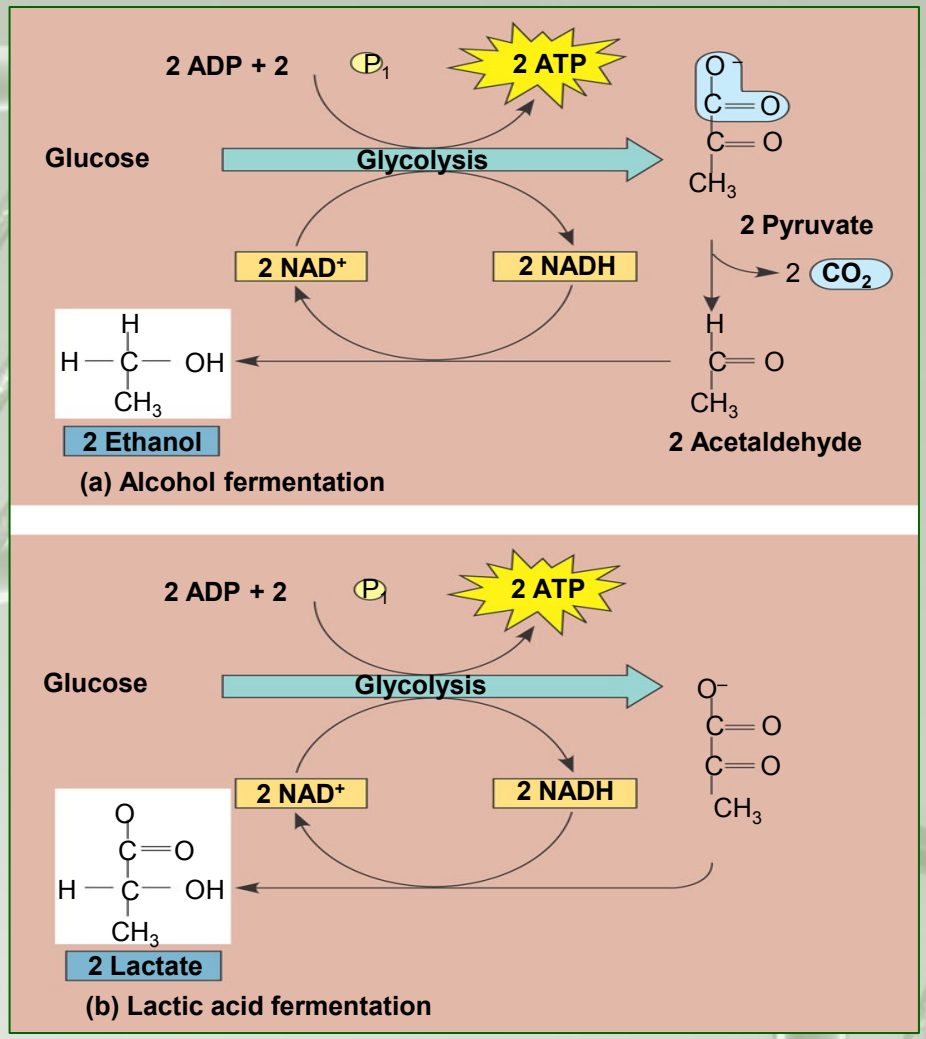
Anaerobic Respiration...

- **Fermentation enables some cells to produce ATP without the use of oxygen**
- **Alcoholic fermentation**
- **Lactic acid fermentation**



GROWTH and Phytohormones…

Auxins ….

- Promote cell elongation in coleoptiles and stems, apical dominance.
- Roles in phototropism and gravitropism
- Notable amounts in bud and leaf meristems and in embryos in seeds
- Indoleacetic acid (IAA) most common auxin in nature

Gibberellins .....

- Promote stem lengthening
- Help end dormancy of seeds and buds
- Contribute to flowering, bolting.
- Notable amounts in apical meristems of buds, roots, and leaves and in embryos

Categories of Plant Hormones.

- Cytokinins
  - Promote cell division and leaf expansion, retard leaf aging
  - Synthesized in roots and travel elsewhere
- Abscisic Acid
  - Promotes stomatal closure, bud and seed dormancy, senescence.
- Ethylene
  - Promotes ripening of fruit, abscission of leaves, flowers, and fruits

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MCQ'S on Photosynthesis,cellular respiration and plant growth.

1. Photosynthesis is …….. Reaction

a. Catabolic

b. Exergonic

c. Redox

d. Oxidative

BIOLOGY

2. The reaction centre of PS II is……

a. P700

b. P680

c. P870

d. P600

3. The site of EMP pathway of breakdown of glucose in a cell is …..

a. Mitochondria
b. Nucleoplasm
c. Peroxysome
d. Cytoplasm

4. Match the following

Column I	Column II
A)Carboxylating Enzyme	p)NADPH
B)Reducing agent	q)Aldolase
C)Condensation enzyme	r)Rubisco

a. A=r, B=q, C=p

b. A=r, B=p, C=q

c. A=q, B=p, C=r

d. A=q, B=r, C=p.

5. Which one among the following is not required for Hill reaction?

a. Sun light
b. PS I and PS II
c. Water
d. Carbon dioxide

6. Hydration reaction of Kreb's cycle involves conversion of……

a. Succinic acid to fumaric acid

b. Isocitric acid to oxalosuccinic acid

c. Fumaric acid to malic acid

d. Malic acid to oxaloacetic acid

7. Chlorophyll of bundle sheath cells are….

a. Larger in size, without grana

b. Smaller in size, without grana

c. Larger in size, with grana

d. Smaller in size, with grana

8. Only ATP is synthesized in …….

a. Cyclic electron transport

b. Noncyclic electron transport

c. Dark reaction

d. Photolysis of water.

9. Carbon assimilation in dark reaction of photosynthesis is …..

a. Linear process

b. Non cyclic process

c. Cyclic process

d. Reversible process

BIOLOGY

10. The rosette habit of cabbage can be changed by application of ……..

a. IAA

b. GA

c. ABA

d. Ethephon.

BIOLOGY

11. CAM pathway is observed in ……..

a. Pineapple

b. Maize

c. Sunflower

d. Sugarcane.

12. In C_4 pathway, the CO_2 fixation in mesophyll cells is carried out by the enzyme .....

a. Rubisco

b. PEP carboxylase

c. Pyruvate decarboxylase

d. Pyruvate dehydrogenase.

BIOLOGY

13. The rate of photosynthesis is independent of…..

a. Light
b.Temperature
c. Water
d. Pressure

14. Match the following

Column I	Column II
1) Ganong's light screen	p) To show chlorophyll is necessary
2)Test tube funnel experiment	q) To show CO_2 is necessary
3) Variegated leaf experiment	r) To show evolution of oxygen
4) Mohl's half leaf experiment	s) To show light is necessary

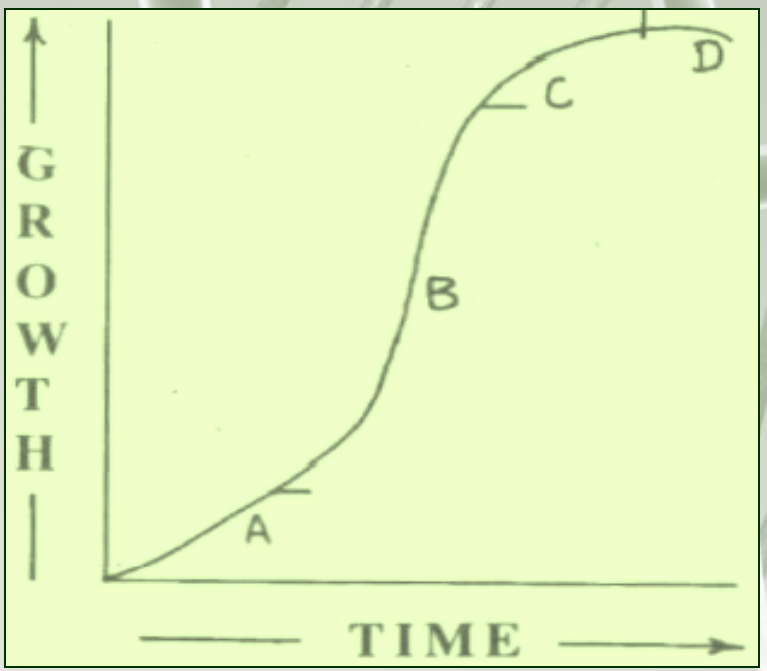
a. 1=s,2=r,3=q,4=p

b. 1=s,2=p,3=q,4=r

c. 1=q,2=p,3=s,4=r

d. 1=s,2=r,3=p,4=q

15. In the sigmoid growth curve given by the side, the alphabets indicate the sequence of events. Choose the correct option.



a. A=Diminishing growth ,B=Exponential growth ,C=Slow growth, D=Stationary growth

b. A= Stationary phase ,B=Slow growth C=Rapid growth ,D=Diminishing growth

c. A=Slow growth ,B=Exponential growth C=Diminishing growth, D=Stationary phase

d. A=Rapid growth ,B=Diminishing growth C=Stationary growth ,D=slow growth

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16. Which one of the following synthetic growth regulators is used to promote flowering in pineapple?

a. Phenylmercuric Acetate

b. Benzyl Aminopurine.

c. 2-chloroethylphosphonic acid

d. Indolebutyric acid.

BIOLOGY

17.Which of the following hormones does not naturally occur in plants?

a. IAA

b. GA

c. ABA

d. 2,4-D

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18. RUBISCO enzyme is also called as……..

a. Carboxytetramutase

b. Carboxydimutase

c. Carboxytrimutase

d. Carboxyunimutase

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19. The visible product of photosynthesis is .....

a. Glucose

b. Cellulose

c. Starch

d. Fructose

20. The isomer of PGAL is ....

a. PGA

b. DHAP

c. PEP

d. OAA

21. Solarisation refers to……

a. Formation of sugar with help of water or energy

b. Destruction of chlorophyll

c. Synthesis of chlorophyll

d. Both b and c

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22. ATP was discovered by ……

a. Lipmann

b. Karl Lohman

c. Blackman

d. Bowman

BIOLOGY

23. Gibberellins were found in …..

a. Coleoptile tip

b. Root tip

c. Fungus

d. Bacterium

BIOLOGY

24. Genetically dwarf plants can be induced to grow tall by using ……..

a. Auxins

b. Cytokinins

c. Gibberellins

d. Phycobillins

BIOLOGY

25. In succulent plants like opuntia, RQ value will be ….

a. Infinity

b. Zero

c. Less than 1

d. More than 1

BIOLOGY

26. The number of ATP produced when a molecule of glucose undergoes fermentation is ….

a. 4

b. 36

c. 2

d. 38

BIOLOGY

27. Oxalosuccinic acid ,an intermediary compound of Kreb's cycle is a ……

a. 4 carbon compound

b. 3 carbon compound

c. 5 carbon compound

d. 6 carbon compound

28. The R.Q during cellular respiration would depend on ……

a. The nature of the substrate

b. The amount of carbon dioxide released

c. The amount of oxygen utilized

d. The nature of enzymes involved

BIOLOGY

29. During terminal oxidation, the final electron acceptor of the ETS is …….

a. Free molecular oxygen

b. Co-Q

c. Cyt.a_3

d. The protons $2H^+$

BIOLOGY

30.Kreb's cycle begins with the reaction …..

a. Citric acid + Acetyl CoA

b. OAA + Acetyl Co-A

c. OAA + citric acid

d. OAA + Pyruvic acid

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31. The atom within each cytochrome molecule that actually accept and releases electron is……

a. C
b. Fe
c. Zn
d. Mg

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32. The Law of Limiting factors was proposed by .....

a. Robert Hill

b. R. Emerson

c. F.F Blackman

d. D.Arnon

33. During Lactic acid fermentation ….

a. Neither O_2 is used nor CO_2 is liberated

b. O_2 is used, CO_2 is liberated

c. O_2 is not used, CO_2 is liberated

d. O_2 is used , CO_2 is not liberated.

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It's not that easy bein' green... but it is essential for life on earth!
GOOD LUCK!!!!
THANK YOU!

BIOLOGY

Enzymes required for Kreb's cycle are located in ……

a. Outer chamber of mitochondria

b. Inner chamber of mitochondria

c. Mitochondria and cytoplasm

d. Cytoplasm only

Compare the statements A and B.

A: Auxins promote apical dominance by suppressing the activity of lateral buds

B: In moriculture, periodic pruning of shoot tips is done to make mulberry plants bushy.

a. Statement A is correct and B is wrong.

b. Statement A is wrong and B is correct.

c. Both the statements A and B are correct and A is not the reason for B.

d. Both the statements A and B are correct and A is the reason for B.

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Bacterial photosynthesis involves …..

a. PS I only

b. PS II only

c. Both PS I and PS II

d. Either PS I or PS II

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Dark reaction of photosynthesis occurs in…… part of chloroplast

a. Outer membrane

b. Inner membrane

c. Periplastidal space

d. Matrix

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Identify from the following, a characteristic pigment associated with chlorophyll-b Molecules ……

a. Ferredoxin
b. Plastoquinone
c. Plastocyanin
d. Cytochrome

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In CAM plants CO_2 required for photosynthesis enters the plant body during ….

a. Daytime when the stomata are open

b. Night when hydathodes are open

c. Daytime through the lenticels

d. Night through the stomata which are kept open

Photosynthesis cannot continue for long if during light reaction only cyclic photophosphorylation takes place,because

a. **There is unidirectional cyclic movement of the electrons**

b. **There is no evolution of O_2**

c. **Only ATP is formed,$NADPH^+ + H^+$ is not formed**

d. **Photosystem I stops getting excited at a wavelength of light beyond 680nm**

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Ganong's respiroscope is used to demonstrate…

a. Evolution of oxygen during photosynthesis

b. Evolution of carbon dioxide during fermentation

c. Production of carbon dioxide during aerobic respiration

d. Production of heat during aerobic respiration

BIOLOGY

Identify the incorrect statement with respect to Calvin cycle.

a. The final stable intermediate compound formed is phosphoglycerate.

b. 18 molecules of ATP are synthesized during carbon fixation.

c. NADPH + H^+ produced in light reaction is used to reduce diphosphoglycerate.

d. The carboxylation of RuBP is catalysed by rubisco.

BIOLOGY

Pyruvate dehydrogenase complex, needed for the conversion of Pyruvic acid to Acetyl CO-A is located in ….

a. Intermembranal space of mitochondria

b. Matrix of Mitochondria

c. Cytoplasm

d. Grana of chloroplast.

BIOLOGY

Match the phenomenon listed under column I with those listed under column II.Select the correct answer…..

	Column I		Column II
A	Warburg effect	p	Change in gene frequency by chance
B	Pasteur effect	q	Postponing severance in the leaves by applying cytokinin
C	Emerson effect	r	Decline in the consumption of respiratory substrate. Due to change from anaerobic to aerobic respiration
D	Wright effect	s	Inhibitory effect of O_2 on photosynthesis
			Enhancement of photosynthesis by subjecting chlorophyll to the effect two different wavelengths of light

a. A=t ,B= s, C=p, D=q

b. A=s, B=r, C=t, D=p

c. A=s ,B=t, C=q, D=r

d. A=t ,B= r, C=p, D=s

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Match the compounds in column I with the number of carbon atoms present in them which are listed in column II and choose the correct answer.

Column I		Column II
Oxaloacetate	p	6-C compound
Phosphoglyceraldehyde	q	5-C compound
Isocitrate	r	4-C compound
α-Ketoglutrate	s	3-C compound
	t	2-C compound

a. A=r, B=s, C=p, D=q

b. A=r, B=t, C=p, D=q

c. A=q, B=s, C=p, D=t

d. A=s, B=t, C=q, D=r

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Which among the following group of plants exhibit xerophytic features?

a. CAM plants

b. C3 plants

c. C4plants

d. Byrophytes

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Granal and Agranal chloroplast are found in…….

a. C3 plants

b. C4 plants

c. CAM plants

d. Bacteria

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In a tissue culture media , the resource of the phytohormone is ….

a. Agar agar
b. Glucose
c. Micronutrients
d. Coconut milk

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Which one of the following reactions is an example of oxidative decarboxylation?

a. Conversion of succinate to fumerate

b. Conversion of fumerate to malate

c. Conversion of pyruvate to acetyl CoA

d. Conversion of citrate to isocitrate

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Identify from the following, the compound that links glycolysis and Krebs cycle.

a. Pyruvic acid

b. Oxalo acetic acid

c. Acetyl Co-A

d. Lactic acid

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The source of CO_2 during calvin cycle in C4 plant is …….

a. Malic acid

b. OAA

c. PEP

d. RuDP

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Chemiosmosis hypothesis given by Peter Mitchel proposes the mechanism of .....

a. Synthesis of NADH

b. Synthesis of ATP

c. Synthesis of $FADH_2$

d. Synthesis of NADPH

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During light phase of photosynthesis …… is oxidized and…… is reduced.

a. CO_2 and water

b. Water and CO_2

c. Water and NADPH

d. $NADPH_2$ and CO_2

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End products of aerobic respiration are

a. Sugar and oxygen

b. Water and energy

c. Carbon dioxide and energy

d. Carbon dioxide ,water and energy