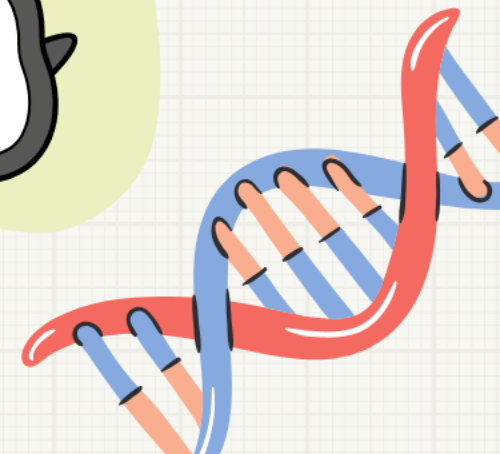




AP Bio

FRQ Fridays

2023 #4
Photosystems/Photosynthesis



FRQ Friday #11

2023 #4

Noncyclic electron flow and cyclic electron flow are two major pathways of the light-dependent reactions of photosynthesis. In noncyclic electron flow, electrons pass through photosystem II, then components of a chloroplast electron transport chain, and then photosystem I before finally reducing NADP^+ to NADPH . In cyclic electron flow, electrons cycle through photosystem I and some components of the electron transport chain (Figure 1).

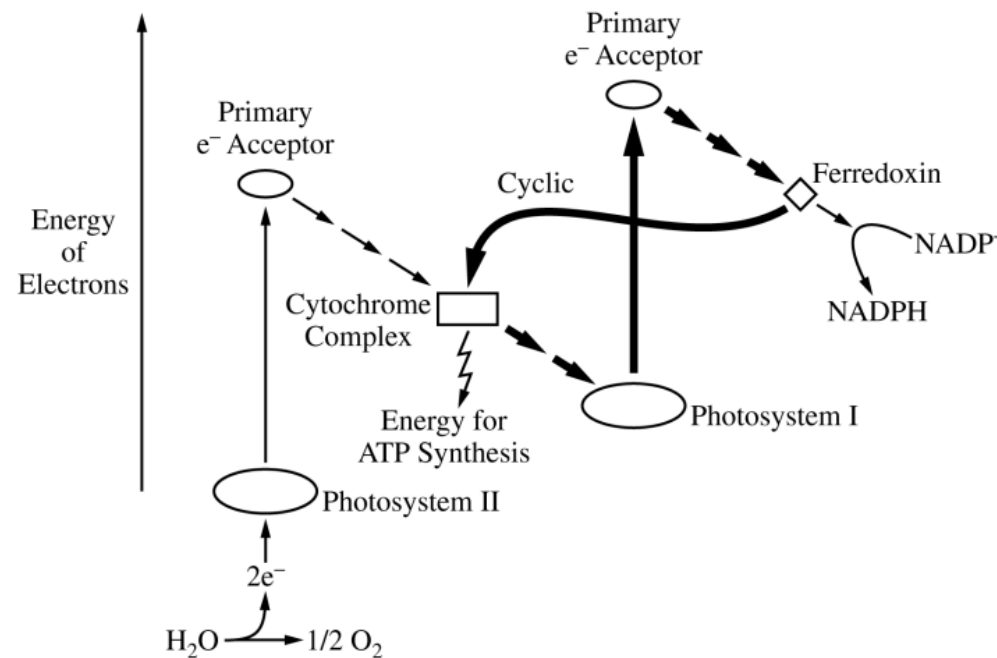


Figure 1. The pathways of noncyclic and cyclic (heavy arrows) electron flow. The cytochrome complex is a component of the electron transport chain between the two photosystems.



FRQ Friday #11

2023 #4

(a) Describe the role of chlorophyll in the photosystems of plant cells.

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1 point

Accept one of the following:

- Chlorophyll captures/absorbs light (energy).
- Chlorophyll receives electrons (from water)/receives electrons (from an electron transport chain)/transfers electrons (to an electron transport chain).



FRQ Friday #11

2023 #4

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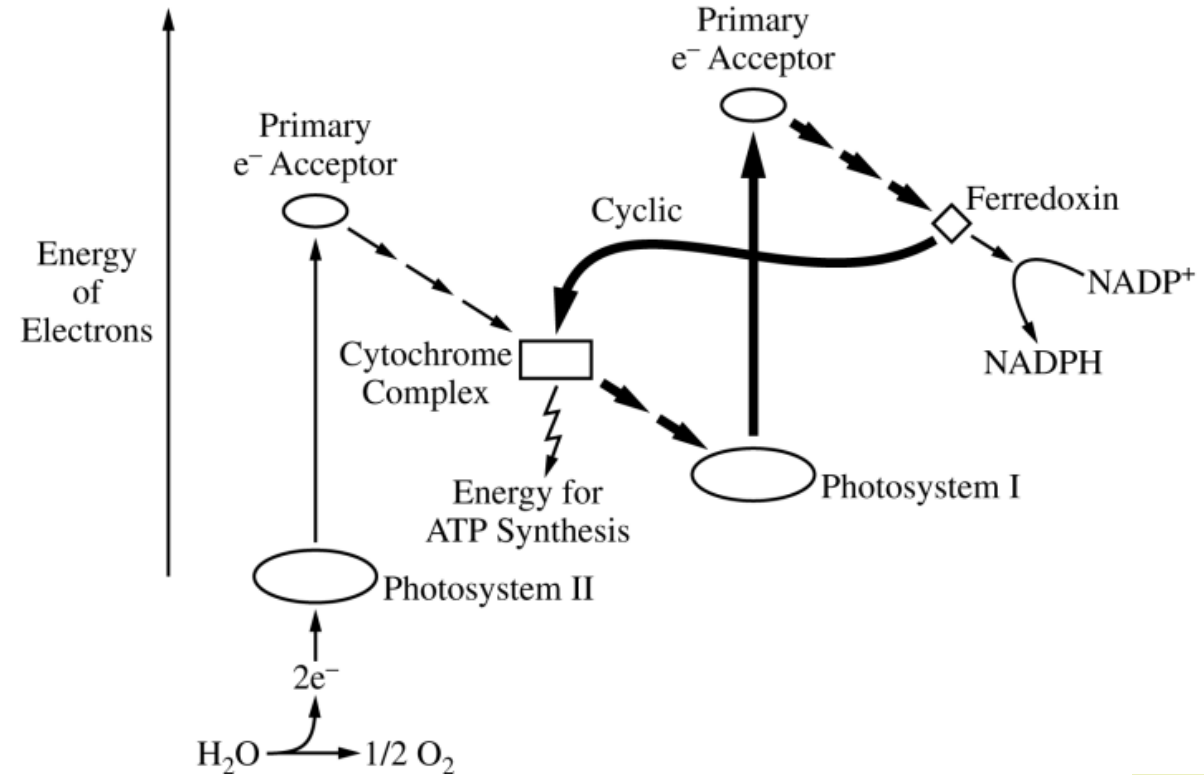
(a) Chlorophyll is a pigment in the photosystems of plant cells that absorb light, which is the source of energy that excites the photosystem's electrons and allow them to move to higher energy electron acceptors that carry the energy to other molecules.



FRQ Friday #11

2023 #4

(b) Based on Figure 1, **explain** why an increase in the ratio of NADPH to NADP⁺ will cause an increase in the flow of electrons through the cyclic pathway.



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1 point

- There is less/no NADP⁺ to accept the electrons, so the electrons pass (instead) to the cyclic pathway/from ferredoxin to the cytochrome complex.

Hi!

FRQ Friday #11

2023 #4

- (b) Based on Figure 1, explain why an increase in the ratio of NADPH to NADP^+ will cause an increase in the flow of electrons through the cyclic pathway. **1 point**
- There is less/no NADP^+ to accept the electrons, so the electrons pass (instead) to the cyclic pathway/from ferredoxin to the cytochrome complex.

(b) An increase in the ratio of NADPH to NADP^+ would increase cyclic electron flow because non cyclic electron flow creates more NADPH. If NADPH concentration is already high, it would inhibit non cyclic electron flow because there is not enough NADP^+ to accept the electrons, so the electrons will be transferred back to the electron transport chain to and photosystem 1.

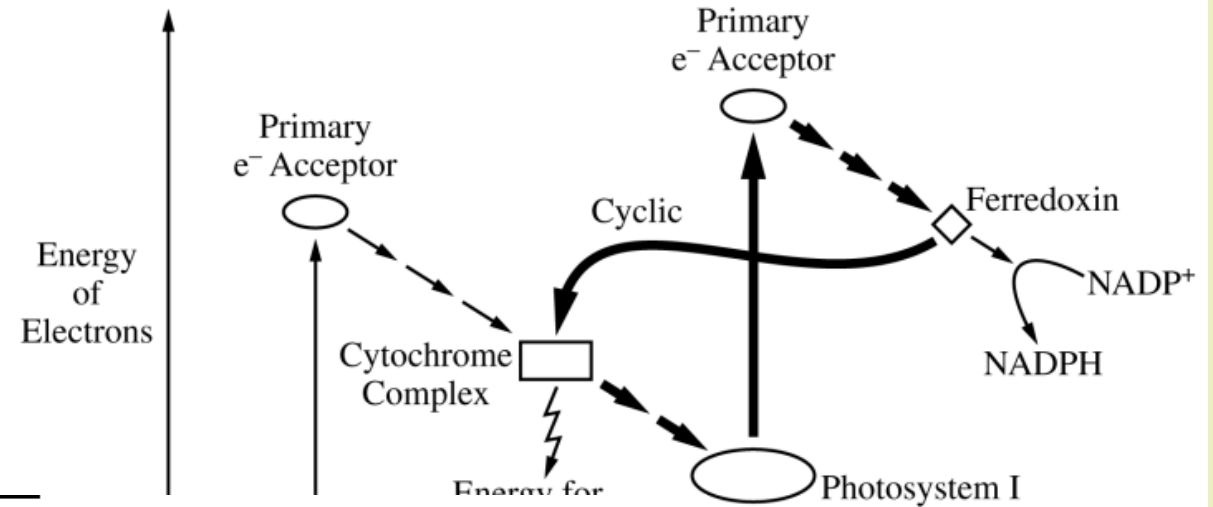


FRQ Friday #11

2023 #4

(c) Using rice plants, scientists examined the effect of a mutation that results in the loss of the protein CRR6. CRR6 is a part of the photosystem I complex, and its absence reduces the activity of photosystem I. **Predict** the effect of the mutation on the rate of biomass (dry weight) accumulation.

(d) **Justify** your prediction in part (c).



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1 point

- The rate (of biomass accumulation)/Biomass/It will be lower (in comparison with plants without the mutation).

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1 point

- There will be insufficient ATP/NADPH produced for the synthesis of carbohydrates/the Calvin cycle.



FRQ Friday #11

2023 #4

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- The rate (of biomass accumulation)/Biomass/It will be lower (in comparison with plants without the mutation).

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- There will be insufficient ATP/NADPH produced for the synthesis of carbohydrates/the Calvin cycle.

(c) The mutation of CRR6 would decrease the rate of biomass accumulation. ^{(d) This is} because less NADP⁺ will be reduced, which is needed for ^{the energy to carry out} carbon fixation in the Calvin cycle that creates the sugars from CO₂ that contribute to the biomass of the plants.





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FRQ Fridays

2023 #4
Photosystems/Photosynthesis