

General Observations:
Both chloroplasts and mitochondria appear to be derived from bacteria

Have membrane not derived from cell's endomembrane system
Membrane structure sets up small-volume compartment for proton gradient (inter membrane space for mito and inside thylakoid for chloro)

Have own (circular) DNA
Have own ribosomes and tRNA

Electron transport:
ReDox reactions that move protons across membrane (this should probably be the pivotal point in your essay)

High-energy electrons carried by nucleotide cofactors

Oxygen

Photosynthesis: electrons in reaction center excited by light are fed into electron transport. These are replaced by oxidizing oxygen in water, releasing free O₂ (released protons help in gradient)

Respiration: use oxygen as final (low-energy) acceptor of electrons. Form water with H⁺ also in the area (helps with proton gradient)

Energy Metabolism (photosynthesis and respiration)

ATP Synthase

Driven by Proton Gradient (need a membrane to maintain gradient)

Uncoupling agents make path for protons that doesn't allow ATP synthesis. This can be good (thermogenin in brown fat cells) or bad (toxins that kill cells.)

NADPH Photosynthesis. Linear flow. Electrons excited by light carried **From** electron Transport **To** Calvin cycle to reduce carbon and make carbohydrates.

Calvin Cycle in stroma of chloroplast

CO₂ fixed from air by RuBisCo
Electrons from NADPH are used to reduce these molecules

each cycle adds a carbon; main product is G3P (three carbon simple sugar)

Yes, can be used for glucose but also everything else. Remember plants are limited for growth if they don't have enough water, nitrogen or phosphorous (also require other trace minerals in much lower amounts).

Remember there is circular flow (no NADPH made and no oxygen released. Probably won't come up in essay)

NADH + H⁺ or FADH₂: respiration
Carries electrons **From** food mostly harvested carbons in Citric Acid Cycle **To** electron transport

Citric Acid Cycle in matrix of mitochondria

Carbons from food oxidized, CO₂ released. Electrons to NAD⁺ (make NADH)

Yes, can come from glucose but also from other carbon sources. Fed in by Acetyl-CoA

Glycolysis If it comes up.
Break down sugar into simpler carbon units fed into Citric Acid Cycle

Also produce NADH which can feed into ETS

Fermentation (lactic acid or ethanol) regenerates NAD⁺ if oxygen not available or otherwise limited to anaerobic respiration

Investment phase (two ATP spent on the way to making a high-energy phosphorylated sugar)

Payoff phase (get 4 back via substrate level phosphorylation for net gain of 2)