Insta-Review: Unit 3

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Cellular Energetics
Cellular Respiration
Photosynthesis
FRQ Discussion

Cellular Energetics

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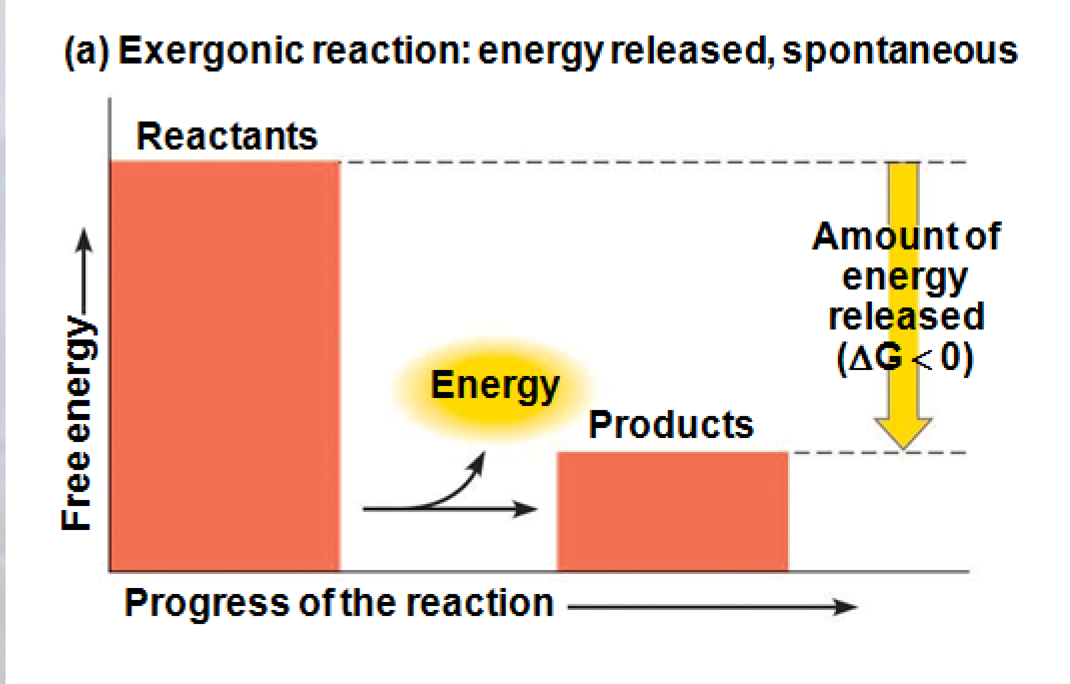

Exergonic:

- - ΔG
- Releases Energy
- Spontaneous

Cellular Energetics

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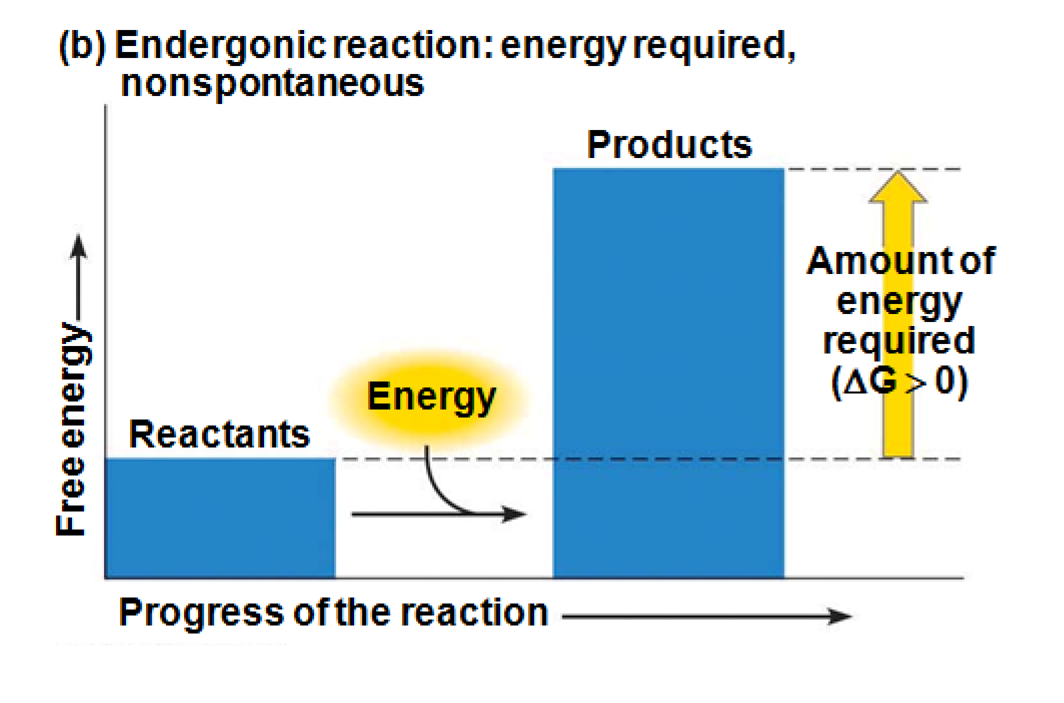
Exergonic:

- $+ \Delta G$
- Absorbs Energy
- Non-spontaneous



Enzymes

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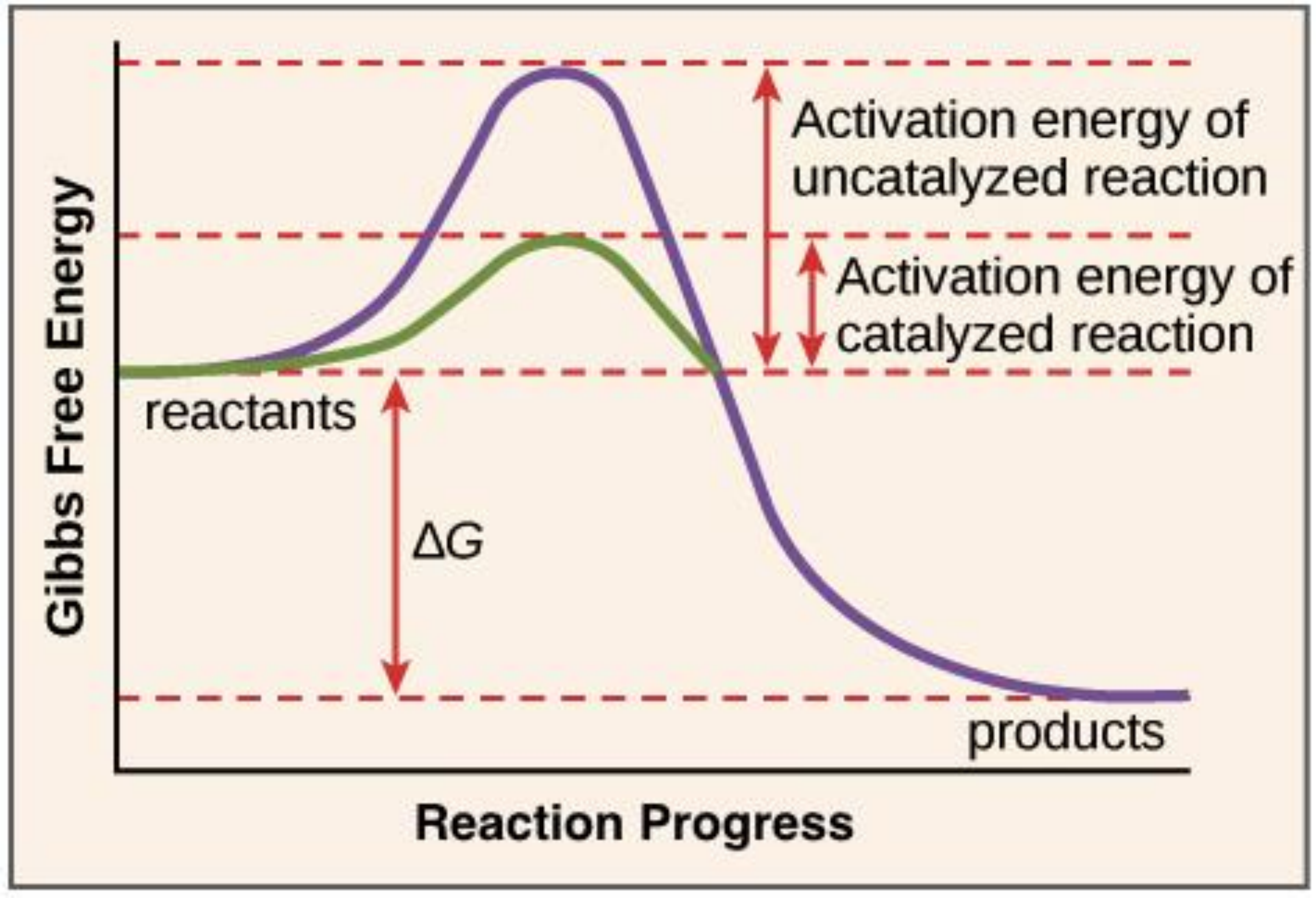

Cellular Respiration

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Glycolysis
(Pyruvate Oxidation)
Krebs Cycle
Oxidative Phosphorylation

Glycolysis

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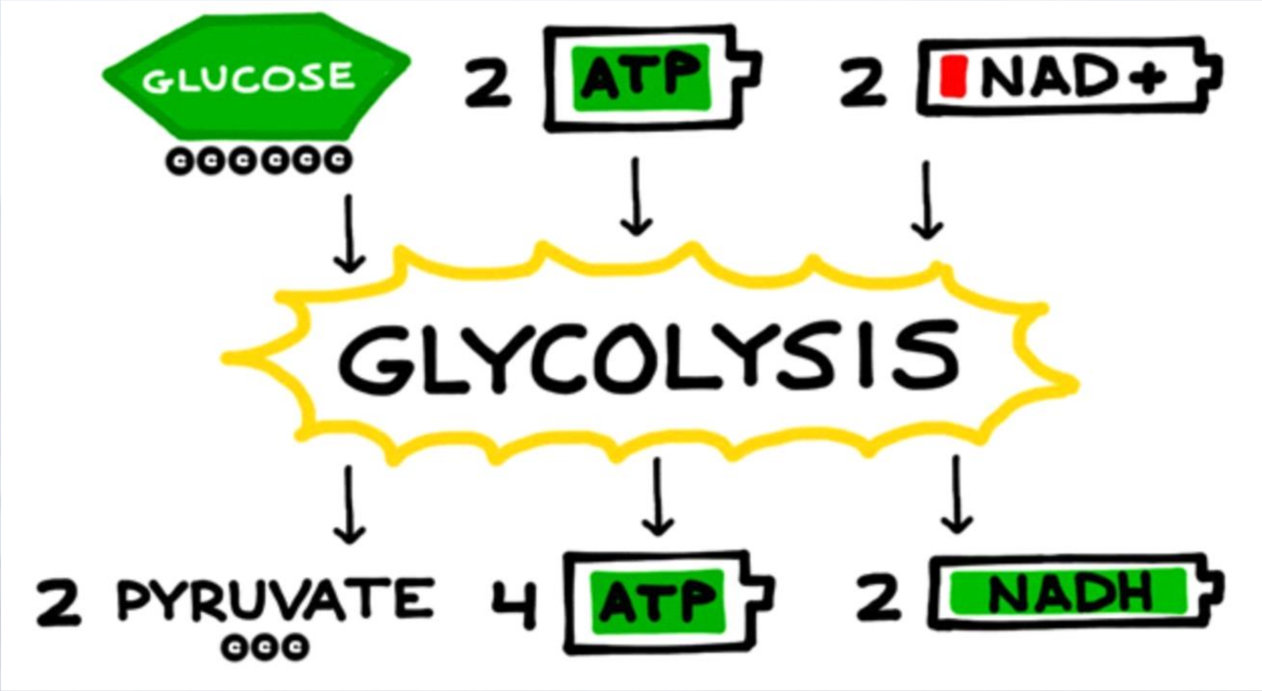
- Location: Cytosol
- Starting Materials
  - Glucose
- Ending Products
  - 2 Pyruvate
  - 2 NADH
  - 2 ATP



Pyruvate Oxidation

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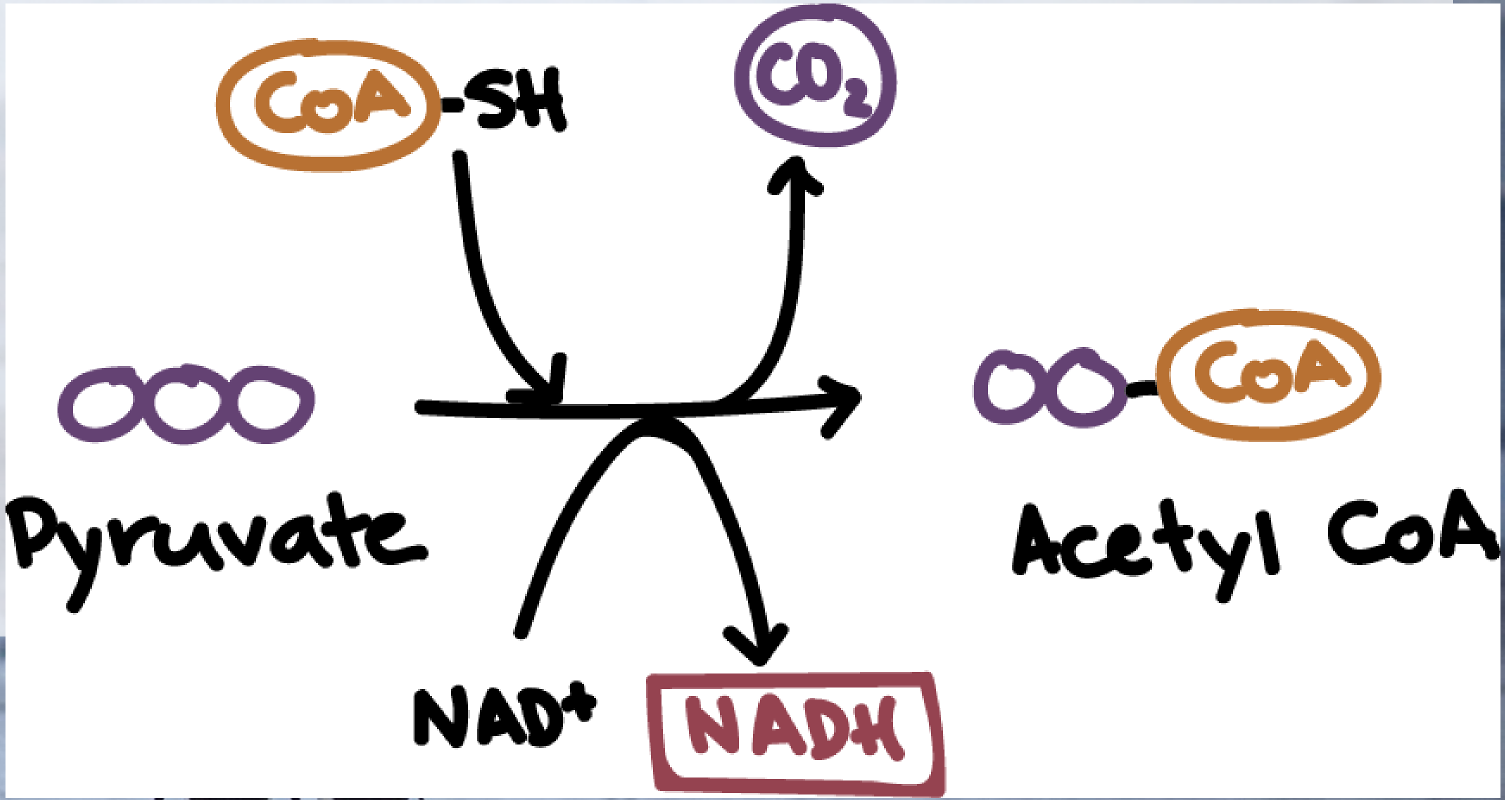
- Location: Mitochondrial Matrix
- Starting Materials
  - Pyruvate
- Ending Products
  - Acetyl CoA
  - 1 CO_2
  - 1 NADH



Krebs Cycle

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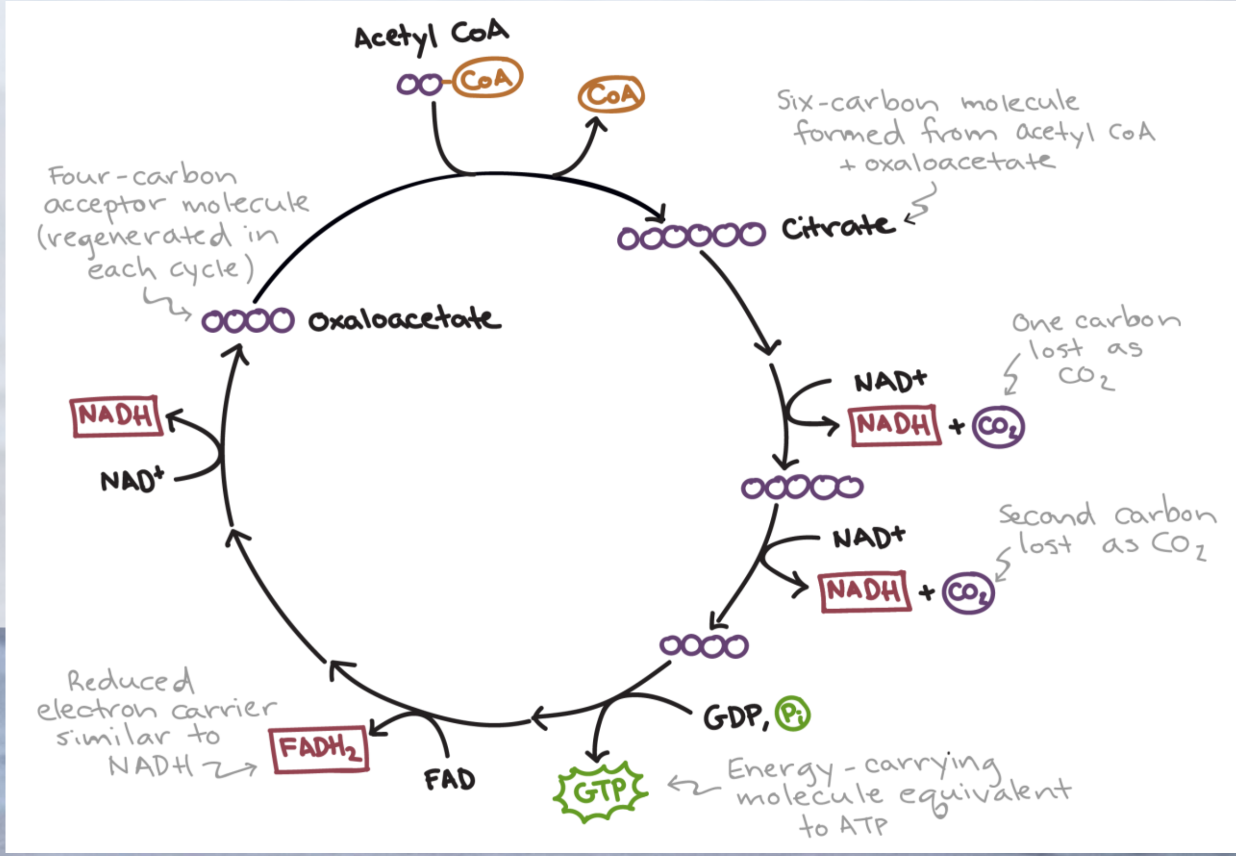
- Location: Mitochondrial Matrix
- Starting Materials
  - Acetyl CoA
- Ending Products
  - 2 CO_2
  - 3 NADH
  - 1 ATP
  - 1 $FADH_2$



Oxidative Phosphorylation

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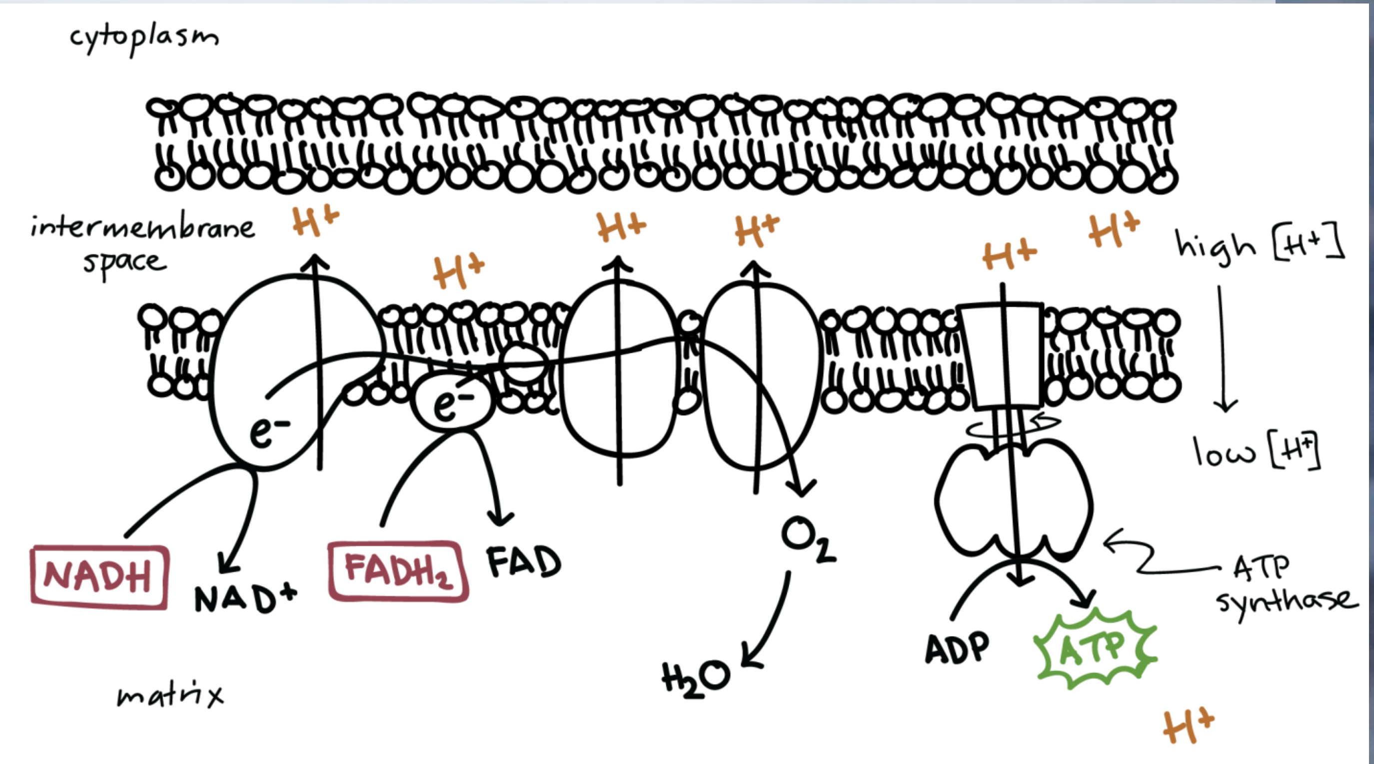
- Location: Mitochondrial Cristae
- Steps:
  - Electron Transport Chain
  - Oxidative Phosphorylation
- Starting Materials
  - Electrons (NADH/$FADH_2$)
- Ending Products
  - ATP



Photosynthesis

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Light Reactions
Calvin Cycle

Light Reactions

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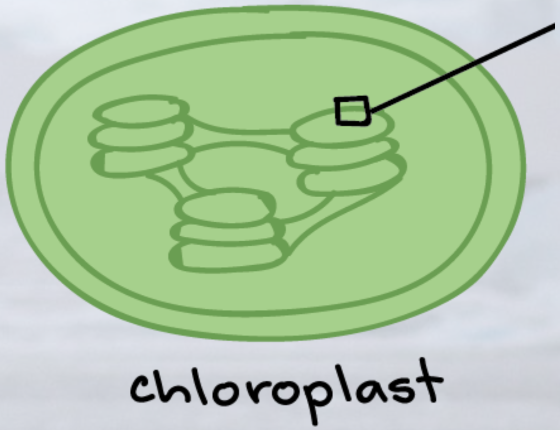
- Location: Thylakoid Membrane
- Starting Materials:
  - H_2O
  - Sunlight
- Ending Materials:
  - ATP
  - NADPH



Light Reactions – Linear Electron Flow

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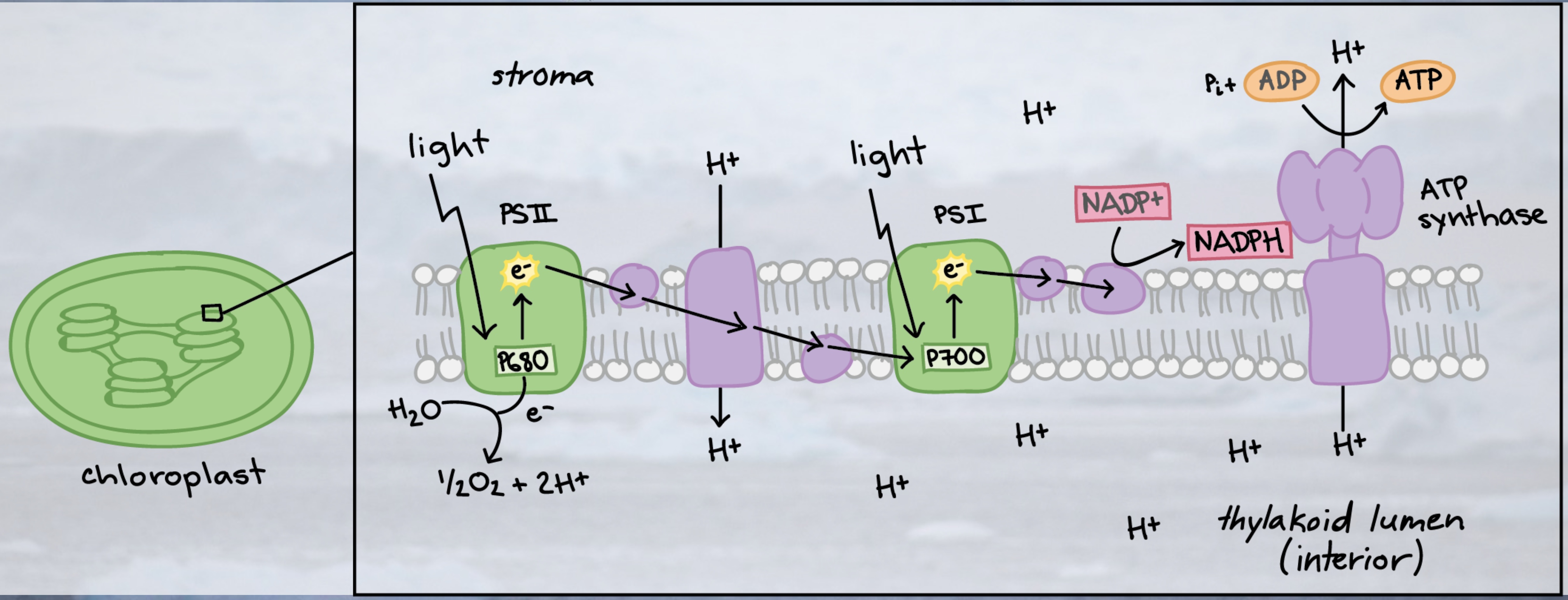

Light Reactions – Cyclic Electron Flow

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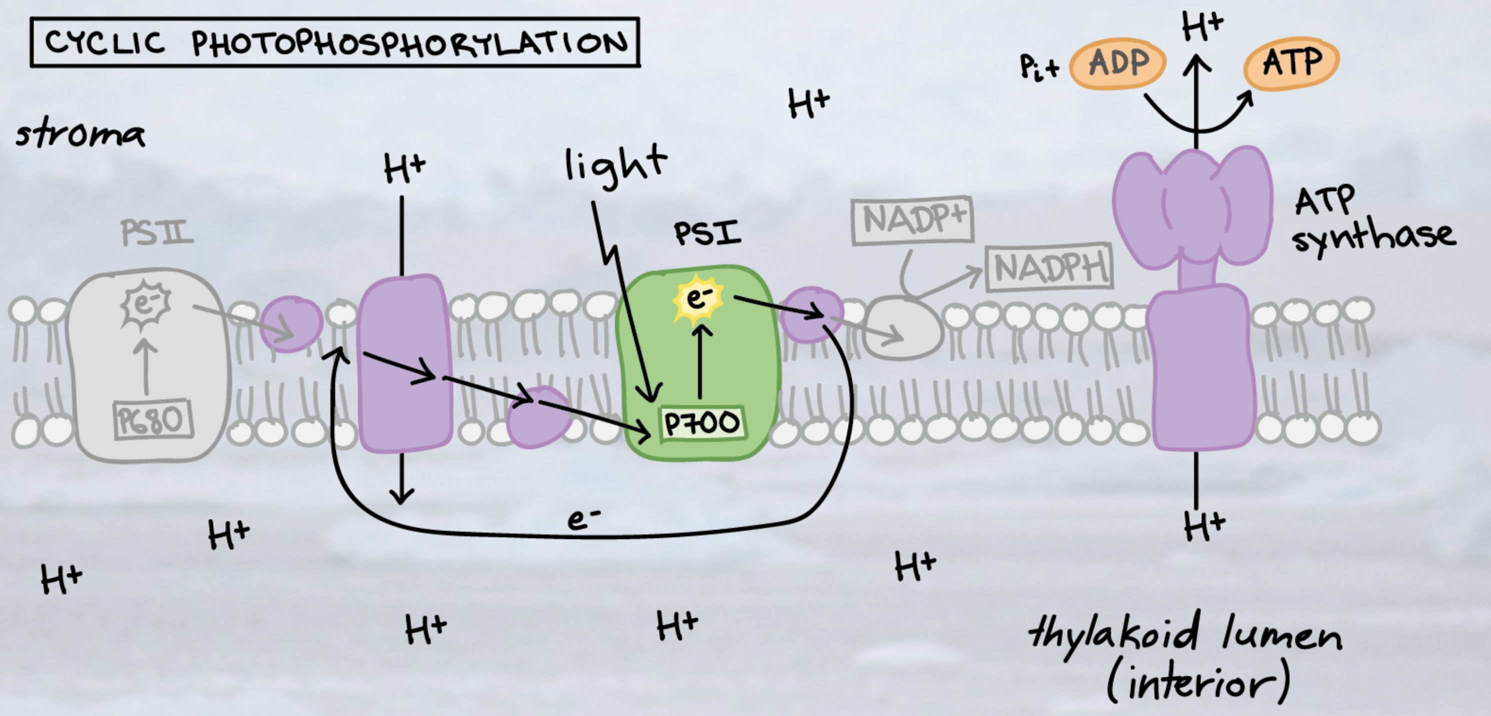

Calvin Cycle

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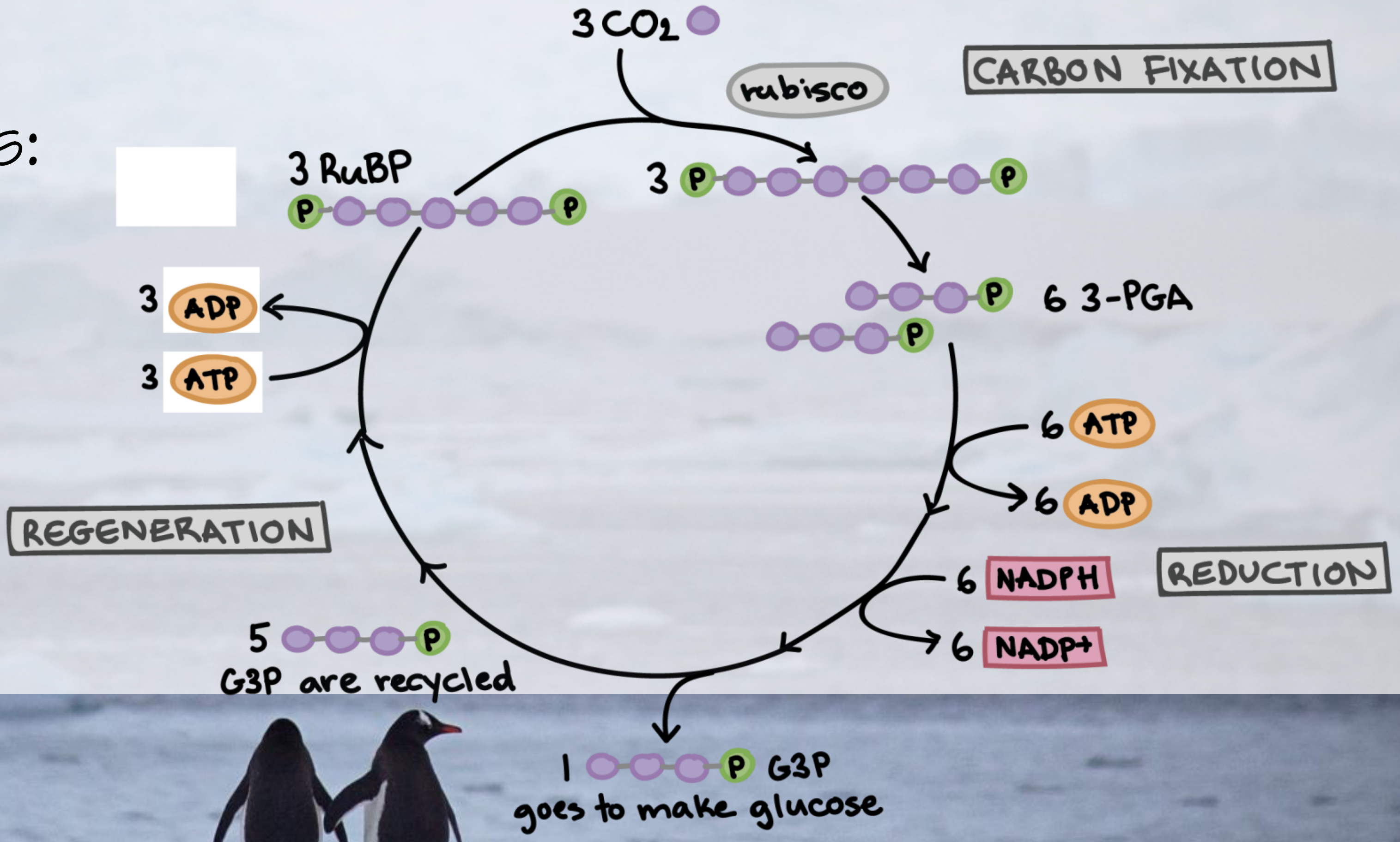
- Location: Stroma
- Starting Materials:
  - CO_2
  - ATP
  - NADPH
- Ending Materials:
  - G3P



FRQ 2019 #3

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The pyruvate dehydrogenase complex (PDC) catalyzes the conversion of pyruvate to acetyl-CoA, a substrate for the Krebs (citric acid) cycle. The rate of pyruvate conversion is greatly reduced in individuals with PDC deficiency, a rare disorder.

(a) **Identify** the cellular location where PDC is most active.

Identification (1 point)

- Mitochondria
- Mitochondrial matrix

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The pyruvate dehydrogenase complex (PDC) catalyzes the conversion of pyruvate to acetyl-CoA, a substrate for the Krebs (citric acid) cycle. The rate of pyruvate conversion is greatly reduced in individuals with PDC deficiency, a rare disorder.

(b) **Make a claim** about how PDC deficiency affects the amount of NADH produced by glycolysis AND the amount of NADH produced by the Krebs (citric acid) cycle in a cell. **Provide reasoning** to support your claims based on the position of the PDC-catalyzed reaction in the sequence of the cellular respiration pathway.

	Claim	Reasoning
Glycolysis	No change	• Glycolysis continues; PDC is not needed. • Glycolysis occurs before conversion of pyruvate to acetyl-CoA.
Krebs cycle	Decrease	• The Krebs cycle is greatly reduced/slowed down if there is no/less acetyl-CoA. • The Krebs cycle occurs after conversion of pyruvate to acetyl-CoA.

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(c) PDC deficiency is caused by mutations in the *PDHA1* gene, which is located on the X chromosome. A male with PDC deficiency and a homozygous female with no family history of PDC deficiency have a male offspring. **Calculate** the probability that the male offspring will have PDC deficiency.

	X	X
X	XX	XX
Y	XY	XY

Calculation (1 point)

- The probability of inheritance is 0.
- The offspring cannot/will not have PDC deficiency.

FRQ 2015 #2

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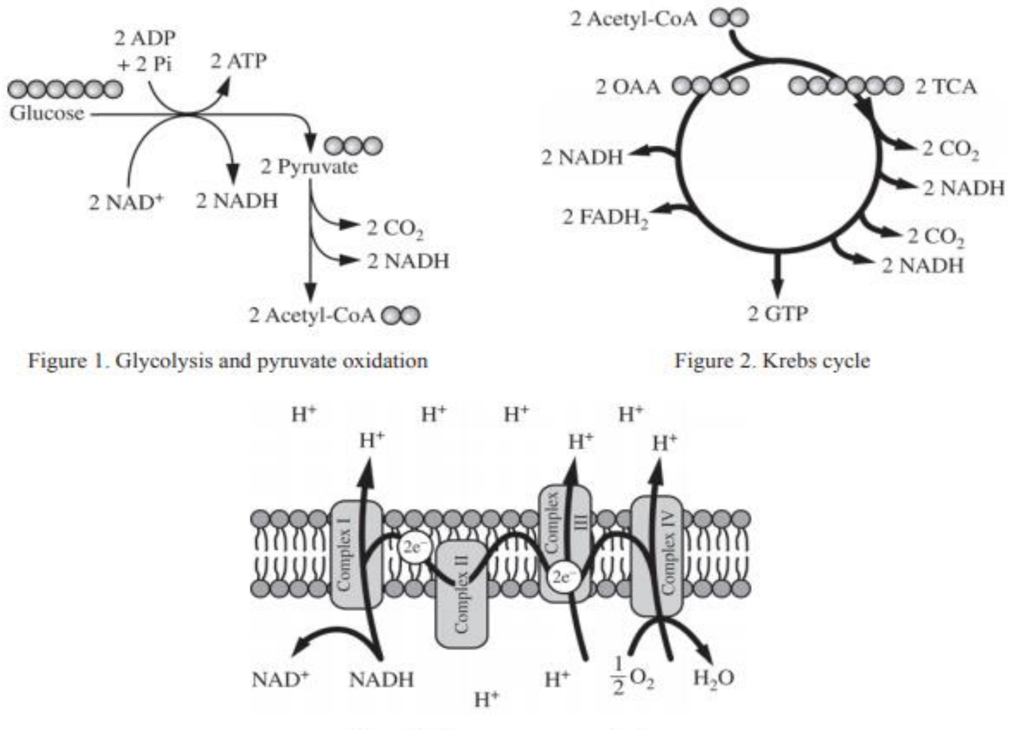

Figure 1. Glycolysis and pyruvate oxidation

Figure 2. Krebs cycle

Figure 3. Electron transport chain

Cellular respiration includes the metabolic pathways of glycolysis, the Krebs cycle, and the electron transport chain, as represented in the figures. In cellular respiration, carbohydrates and other metabolites are oxidized, and the resulting energy-transfer reactions support the synthesis of ATP.

FRQ 2015 #2

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(a) Using the information above, **describe** ONE contribution of <u>each</u> of the following in ATP synthesis.

- Catabolism of glucose in glycolysis and pyruvate oxidation

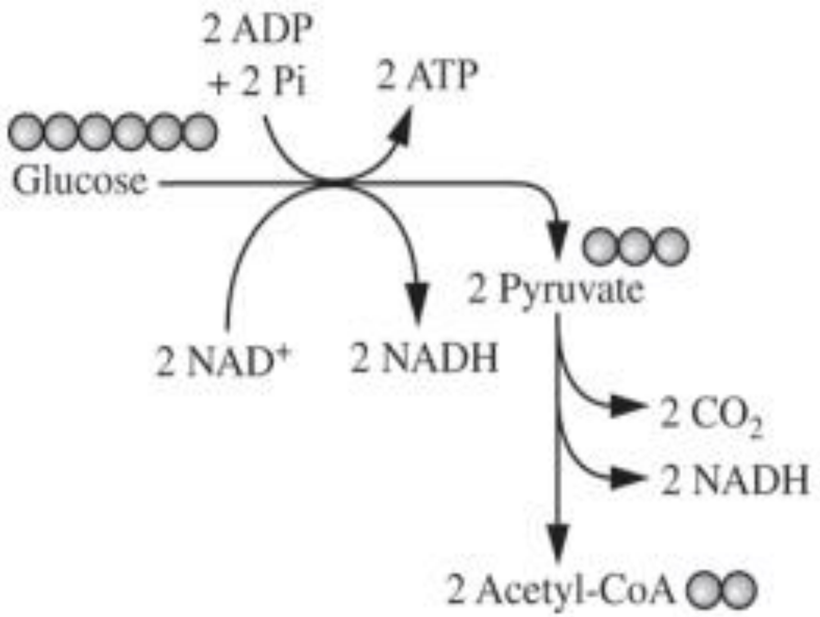

Figure 1. Glycolysis and pyruvate oxidation

Description (1 point each box; 3 points maximum)
• Produces NADH for use in ETC • Produces acetyl-CoA for entry into Krebs cycle • Provides energy for (substrate level) phosphorylation of ADP

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(a) Using the information above, **describe** ONE contribution of <u>each</u> of the following in ATP synthesis.

- Oxidation of intermediates in the Krebs cycle

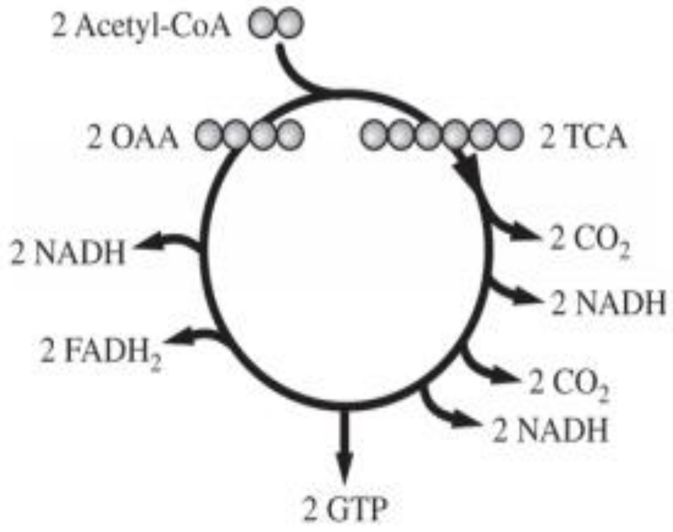

Figure 2. Krebs cycle

Description (1 point each box; 3 points maximum)
• Produces NADH or FADH2 for use in ETC • Releases high energy electrons for use in ETC • Provides energy to pump protons against their concentration gradient • Produces GTP for (substrate level) phosphorylation of ADP

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(a) Using the information above, **describe** ONE contribution of each of the following in ATP synthesis.

- Formation of a proton gradient by the electron transport chain

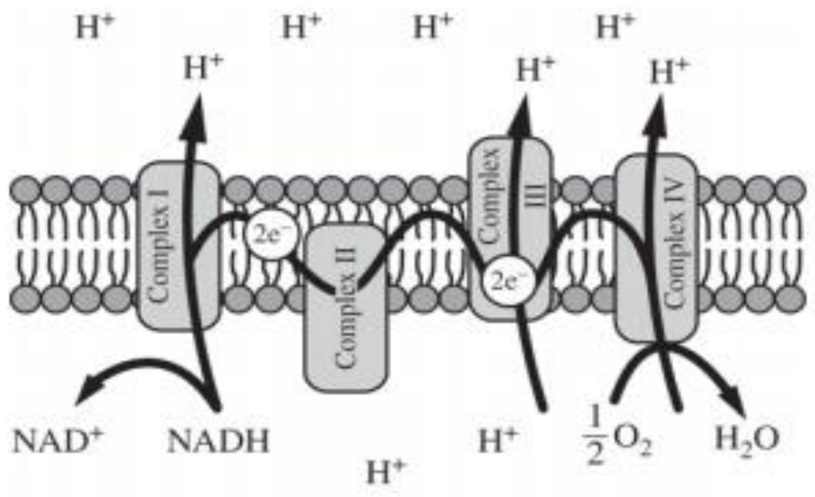

Figure 3. Electron transport chain

Description (1 point each box; 3 points maximum)
• The flow of protons through membrane-bound ATP synthase generates ATP • Provides energy for (oxidative) phosphorylation of ADP

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(b) Use each of the following observations to **justify** the claim that glycolysis first occurred in a common ancestor of all living organisms.

- Nearly all existing organisms perform glycolysis.
- Glycolysis occurs under anaerobic conditions.
- Glycolysis occurs only in the cytosol.

Observation	**Justification (1 point each box; 3 points maximum)**
Nearly all existing organisms perform glycolysis	• Trait/gene/process originated early and was inherited/passed down/highly conserved • Glycolysis provided a selective advantage that was passed on to descendants
Glycolysis occurs under anaerobic conditions	Origin of glycolysis pre-dates free atmospheric oxygen/photosynthesis
Glycolysis occurs only in the cytosol	Origin of glycolysis pre-dates cell types with membrane-bound organelles/eukaryotes/endosymbiosis

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(c) A researcher estimates that, in a certain organism, the complete metabolism of glucose produces 30 molecules of ATP for each molecule of glucose. The energy released from the total oxidation of glucose under standard conditions is 686 kcal/mol. The energy released from the hydrolysis of ATP to ADP and inorganic phosphate under standard conditions is 7.3 kcal/mol. **Calculate** the amount of energy available from the hydrolysis of 30 moles of ATP. **Calculate** the efficiency of total ATP production from 1 mole of glucose in the organism. **Describe** what happens to the excess energy that is released from the metabolism of glucose.

30 moles produced x 7.3 kcal/mole = 219 kcal

Glucose has 686 kcal/mol

Efficiency = 219 kcal/686 kcal = 0.319

31% or 32%

The excess energy is released as heat.

Quizizz Games

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Unit 3

Enzymes: **1848 4118**
Photosynthesis: **2372 6998**
Cellular Respiration: **1953 2694**
Glycolysis: **5150 8118**
Krebs Cycle: **2739 0870**
Oxidative Phosphorylation: **6704 0150**

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