AP BIO INSTA-REVIEW

TOPIC 3.5

Photosynthesis

ENE-1.I.1

Organisms capture and store energy for use in biological processes–

a. Photosynthesis captures energy from the sun and produces sugars.

i. Photosynthesis first evolved in prokaryotic organisms.

ii. Scientific evidence supports the claim that prokaryotic (cyanobacterial) photosynthesis was responsible for the production of an oxygenated atmosphere.

iii. Prokaryotic photosynthetic pathways were the foundation of eukaryotic photosynthesis.

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Photosynthesis

ENE-1.I.2

The light-dependent reactions of photosynthesis in eukaryotes involve a series of coordinated reaction pathways that capture energy present in light to yield ATP and NADPH, which power the production of organic molecules.

ENE-1.J.1

During photosynthesis, chlorophylls absorb energy from light, boosting electrons to a higher energy level in photosystems I and II.

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Photosynthesis

ENE-1.J.2

Photosystems I and II are embedded in the internal membranes of chloroplasts and are connected by the transfer of higher energy electrons through an electron transport chain (ETC).

ENE-1.J.3

When electrons are transferred between molecules in a sequence of reactions as they pass through the ETC, an electrochemical gradient of protons (hydrogen ions) is established across the internal membrane.

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Photosynthesis

ENE-1.J.4

The formation of the proton gradient is linked to the synthesis of ATP from ADP and inorganic phosphate via ATP synthase.

ENE-1.J.5

The energy captured in the light reactions and transferred to ATP and NADPH powers the production of carbohydrates from carbon dioxide in the Calvin cycle, which occurs in the stroma of the chloroplast.

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Where did photosynthesis originate?

A. Algae

B. Cyanobacteria

C. Plants

D. Protists

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Where did photosynthesis originate?

B. Cyanobacteria

Photosynthesis originated in the cyanobacteria in the oceans. This is observed by the iron oxide banding patterns in the fossil evidence.

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Earth included oxygen when it was first formed

A. True

B. False

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Earth included oxygen when it was first formed

B. False

Oxygen gas was not available in Early Earth. Oxygen was generated as a by-product of photosynthesis. The oxygen atom was involved in CO_2, and H_2O among other molecules.

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What evidence do scientists have to determine when O_2 came?

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TOPIC 3.5

What evidence do scientists have to determine when O_2 came?

Iron oxide (rust) layers in the rock layers of fossils

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TOPIC 3.5

Where was oxygen initially formed?

A. Atmosphere

B. Land

C. Meteorite

D. Ocean

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Where was oxygen initially formed?

D. Ocean

The cyanobacteria lived in the oceans so the process of photosynthesis took place in the oceans. The by-product of photosynthesis is oxygen, so therefore the oxygen was initally formed in the oceans.

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Based on endosymbiotic theory, where did chloroplasts come from?

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TOPIC 3.5

Based on endosymbiotic theory, where did chloroplasts come from?

Engulfed photosynthetic prokaryotes

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TOPIC 3.5

Which step of photosynthesis stores solar energy as ATP?

A. Calvin Cycle

B. Glycolysis

C. Krebs Cycle

D. Light Reactions

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TOPIC 3.5

Which step of photosynthesis stores solar energy as ATP?

D. Light Reactions

The light reactions use solar energy. The photosystems involve pigments that absorb the energy which is used to pump protons across a membrane creating a proton gradient that is used by ATP Synthase to synthesize ATP.

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Which step of photosynthesis stores high energy electrons as NADPH?

A. Calvin Cycle

B. Glycolysis

C. Krebs Cycle

D. Light Reactions

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TOPIC 3.5

Which step of photosynthesis stores high energy electrons as NADPH?

D. Light Reactions

The electron transport chain after photosystem I ends with $NADP^+$ accepting the electrons to become NADPH. The NADPH will carry the électrons to the Calvin Cycle for the reduction phase.

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Which step of photosynthesis synthesizes G3P?

A. Calvin Cycle

B. Glycolysis

C. Krebs Cycle

D. Light Reactions

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TOPIC 3.5

Which step of photosynthesis synthesizes G3P?

A. Calvin Cycle

The by-product of the Calvin Cycle is G3P. After the reduction phase of the Calvin Cycle, there are six G3P molecules. One is removed to be used to synthesize sugars and the other five will undergo rearrangement to make the RuBP that started the cycle.

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TOPIC 3.5

Which step of photosynthesis takes place in stroma?

A. Calvin Cycle

B. Glycolysis

C. Krebs Cycle

D. Light Reactions

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TOPIC 3.5

Which step of photosynthesis takes place in stroma?

A. Calvin Cycle

Calvin cycle takes place in the stroma (cytosol of the chloroplast) while the Light Reactions take place on the thylakoid membrane.

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TOPIC 3.5

Which step of photosynthesis takes place in the thylakoid?

A. Calvin Cycle

B. Glycolysis

C. Krebs Cycle

D. Light Reactions

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TOPIC 3.5

Which step of photosynthesis takes place in the thylakoid?

D. Light Reactions

The light reactions take place on the thylakoid membrane while the Calvin Cycle takes place in the stroma.

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In a plant cell, where is ATP synthesized?

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TOPIC 3.5

In a plant cell, where is ATP synthesized?

In the electron transport chain...

Chloroplast has an ETC in the light reactions of the thylakoid.

Mitochondria has an ETC in oxidative phosphorylation on the cristae.

Don't get tripped up on this type of question. ATP synthesized by mitochondria is for cellular energy vs. ATP synthesized by chloroplast is for synthesis of G3P.

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Where does photolysis take place?

A. Cytosol

B. Photosystem I

C. Photosystem II

D. Stroma

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TOPIC 3.5

Where does photolysis take place?

C. Photosystem II

Photolysis is the process where the water molecule is broken into oxygen gas, hydrogen ions, and electrons. This takes place at the first photosystem in the linear electron flow called Photosystem II.

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What is photolysis?

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What is photolysis?

The process of using light energy to split a water molecule.

The water molecule is split into oxygen and hydrogen and electrons. These electrons replace the ones that were taken from the reaction center complex.

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Describe the flow of electrons through the light reactions.

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TOPIC 3.5

Describe the flow of electrons through the light reactions.

Electrons are taken from the reaction center complex in Photosystem II, travel down an electron transport chain to Photosystem I, then down another electron transport chain to be stored in NADPH.

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Which direction are hydrogen ions pumped for the electron transport chain in photosynthesis?

A. Into the cytosol

B. Into the intermembrane space

C. Into the stroma

D. Into the thylakoid space

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TOPIC 3.5

Which direction are hydrogen ions pumped for the electron transport chain in photosynthesis?

D. Into the thylakoid space

The hydrogen ions need to be pumped into a small space to increase the concentration gradient quickly and efficiently. The hydrogen ions are pumped INTO the thylakoid space.

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What is synthesized in the light reactions for use in the Calvin Cycle?

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TOPIC 3.5

What is synthesized in the light reactions for use in the Calvin Cycle?

ATP & NADPH

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TOPIC 3.5

Where does Calvin Cycle take place?

A. Cristae

B. Cytosol

C. Stroma

D. Thylakoid

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TOPIC 3.5

Where does Calvin Cycle take place?

C. Stroma

Calvin Cycle takes place in the stroma while the light reactions take place in the thylakoid membrane.

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What are the three steps of the Calvin Cycle?

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TOPIC 3.5

What are the three steps of the Calvin Cycle?

Carbon fixation

Reduction

Rearrangement

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TOPIC 3.5

What enzyme used is for carbon fixation?

A. ATP Synthase

B. Decarboxylase

C. PEP Carboxylase

D. Rubisco

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TOPIC 3.5

What enzyme used is for carbon fixation?

D. Rubisco

Carbon fixation is the first step of the Calvin Cycle. The rubisco is responsible for fixing the CO_2 to the RuBP to make the first intermediate of the cycle.

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How many carbon dioxides are used in the Calvin Cycle?

A. 1
B. 2
C. 3
D. 6

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TOPIC 3.5

How many carbon dioxides are used in the Calvin Cycle?

c. 3

Since the product of the Calvin Cycle is the G3P, which has 3 carbons, it would be logical that 3 CO_2 need to be added to the cycle to be used for the process.

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What is the product of the Calvin Cycle?

A. 3PG

B. G3P

C. PGAL

D. RuBP

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TOPIC 3.5

What is the product of the Calvin Cycle?

B. G3P

The Calvin Cycle makes 6 molecules of G3P. One of the G3Ps are removed while the other 5 will continue in the cycle to synthesize RuBP.

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How many ATPs and NADPHs are needed for the Calvin Cycle? Where do the extra come from?

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TOPIC 3.5

How many ATPs and NADPHs are needed for the Calvin Cycle? Where do the extra come from?

9 ATP and 6 NADPH
(6 ATP and 6 NADPH in reduction & 3 ATP in rearrangement)

The extra ATP comes from cyclic electron flow.

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What is cyclic electron flow?

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TOPIC 3.5

What is cyclic electron flow?

Electrons flow from the Photosystem II to Photosystem I through the ETC to facilitate ATP synthesis, then when the electron gains energy in Photosystem I it goes down the ETC between Photosystem II and Photosystem I. It cycles using only the ETC and Photosystem I only.

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How are the light reactions and the Calvin cycle related?

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TOPIC 3.5

How are the light reactions and the Calvin cycle related?

The light reactions synthesizes the 9 ATP and 6 NADPH to use in the Calvin cycle

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TOPIC
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What is the function of photosynthesis?

A. Capture sunlight and produce sugars
B. Capture ATP and produce ion gradients
C. Capture sugars and produce sunlight
D. Capture ions and produce ATP

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TOPIC 3.5

What is the function of photosynthesis?

A. Capture sunlight and produce sugars

Photosynthesis is completed by photoautotrophs. They will use light energy to synthesize organic molecules (like sugar) from inorganic molecules.

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TOPIC 3.5

Which provided evidence of oxygen generation in the atmosphere?

A. Production of ATP without a mitochondria

B. Production of fire on earth's surface

C. Production of iron oxide bands in rock layers

D. Production of organic compounds

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TOPIC 3.5

Which provided evidence of oxygen generation in the atmosphere?

C. Production of iron oxide bands in rock layers

The iron will oxidize in the presence of oxygen. The fossil evidence shows banding in the rock layers which represents the generation of oxygen by photosynthesis.

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Which describes light independent reactions?

A. Calvin cycle to break bonds to release carbon dioxide

B. Calvin cycle to synthesize organic compounds

C. Krebs cycle to break bonds to release carbon dioxide

D. Krebs cycle to synthesize organic compounds

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TOPIC 3.5

Which describes light independent reactions?

B. Calvin cycle to synthesize organic compounds

Light independent reactions involves a process that does NOT require light. The Calvin Cycle itself does not require the light, but the products of the light reactions.

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TOPIC 3.5

Where do the light independent reactions take place?

A. Cytosol

B. Matrix

C. Stroma

D. Thylakoid

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TOPIC 3.5

Where do the light independent reactions take place?

C. Stroma

The light independent reactions are the Calvin Cycle which takes place in the stroma, while the light dependent reactions take place in the thylakoid membrane.

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Which describes light dependent reactions?

A. Light is absorbed to synthesize ATP & NADPH

B. Light is absorbed to create a sodium gradient

C. Light is used to synthesize organic compounds

D. Light is used to heat the cell increasing reaction rate

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TOPIC 3.5

Which describes light dependent reactions?

A. Light is absorbed to synthesize ATP & NADPH

The light dependent reactions is the light reactions. This process uses the photosystems to synthesize ATP and NADPH in the presence of light and water.

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Describe how ATP is synthesized in the light dependent reactions.

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TOPIC 3.5

Describe how ATP is synthesized in the light dependent reactions.

The light energy is absorbed by pigments in the reaction center complex causing the electrons to move to a higher energy level. As these electrons pump protons across the membrane, the electron falls in energy level. The proton gradient will flow through ATP synthase which phosphorylates ADP to synthesize ATP.

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TOPIC 3.5

Where would you find chlorophyll?

A. Cytosol

B. Mitochondria

C. Ribosome

D. Thylakoid

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TOPIC 3.5

Where would you find chlorophyll?

D. Thylakoid

Chlorophyll is the pigment used in the photosystems to absorb the light energy. The photosystems are part of the light reactions which take place in the thylakoid membrane.