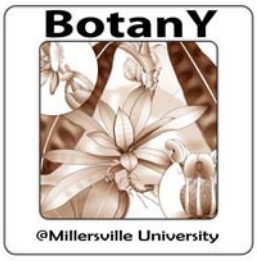
Topic 06



Photosynthesis

Hoefnagles (2018) Chap. 5

I. Introduction

A. Summary Eqn

Light

$6\ CO_2 + 6\ H_2O$ >>>>>> $C_6H_{12}O_6 + 6\ O_2$

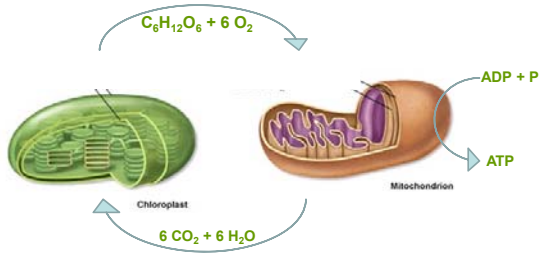
Light

$6\ CO_2 + 12\ H_2O$ >>>>>> $C_6H_{12}O_6 + 6\ O_2 + 6\ H_2O$

I. Introduction

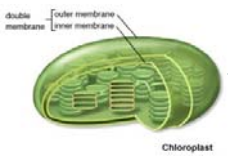
B. Destiny of carbohydrates

1. ATP needs



I. Introduction

B. Destiny of carbohydrates
2. Various Organics



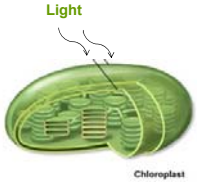
$6\ O_2$

$C_6H_{12}O_6$

- Starch
- Cellulose
- Amino Acids
- Lipids
- Pigments
- Floral Fragrances
- Hormones
- Alkaloids
- THC
- Etc.

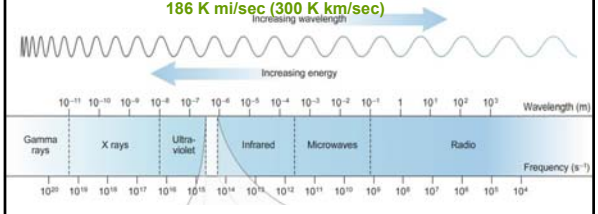
I. Introduction

C. Light & Pigments



I. Introduction

C. Light & Pigments
1. Electromagnetic Spectrum
a. EM radiation speed is constant
186 K mi/sec (300 K km/sec)



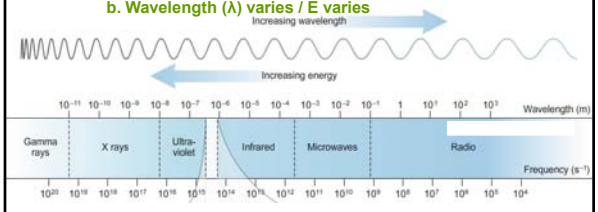
I. Introduction

C. Light & Pigments

1. EM Spectrum

a. EM radiation speed is constant

b. Wavelength (λ) varies / E varies



I. Introduction

C. Light & Pigments

1. EM Spectrum

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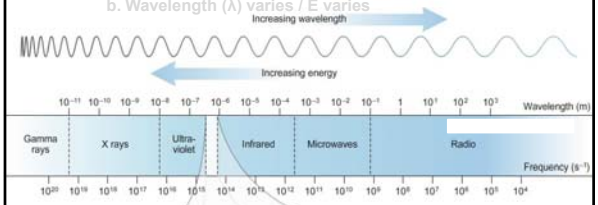
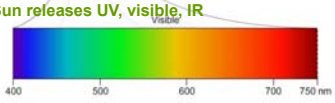
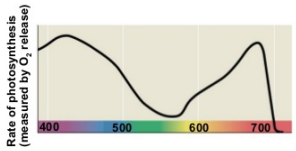


c. Sun releases UV, visible, IR



I. Introduction

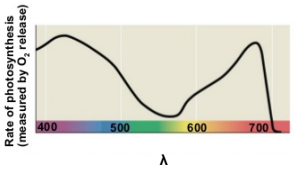
d. Photosynthesis Action Spectrum falls within visible light.



Action Spectrum for Photosynthesis

I. Introduction

d. Photosynthesis Action Spectrum falls within visible light.



Action Spectrum for Photosynthesis

I. Introduction

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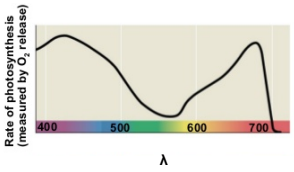
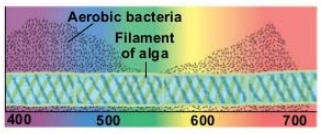


Action Spectrum for Photosynthesis

1) Shorter λ's too energetic
2) Longer λ's E too low.
3) Green & Yellow Green λ's not absorbed

I. Introduction

d. Photosynthesis Action Spectrum falls within visible light.

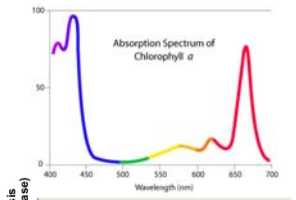


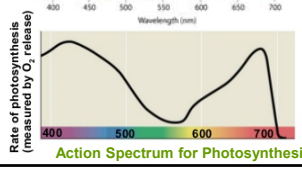
1) Shorter λ's too energetic
2) Longer λ's E too low.
3) Green & Yellow Green λ's not absorbed
4) Theodor Engelmann's (Germany) 1883 experiments.

I. Introduction

2. Which pigments are important?

a) Absorption spectrum for chlorophylls





Action Spectrum for Photosynthesis

I. Introduction

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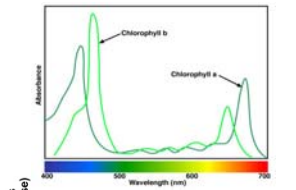
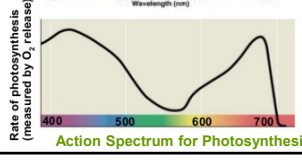




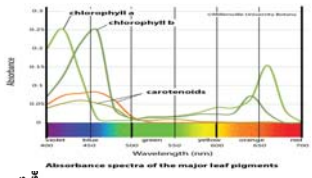
Action Spectrum for Photosynthesis

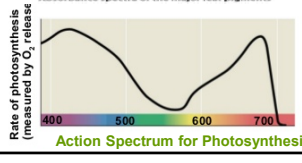
I. Introduction

2. Which pigments are important?

a) Absorption spectrum for chlorophylls

b) AS for carotenoids



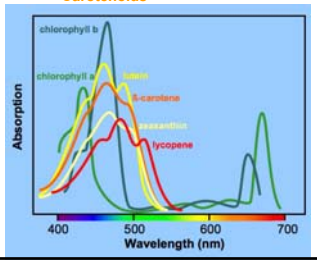


Action Spectrum for Photosynthesis

I. Introduction

2. Which pigments are important?

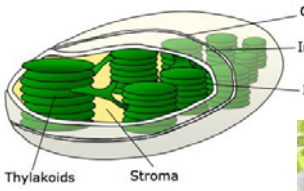
a) Absorption spectrum for chlorophylls
b) AS for carotenoids
c) Necessary: Chl. a
d) Accessory Pigments:
Chl. b
Carotenoids

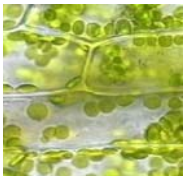


II. Process Review

A. Where?

- Chloroplasts of mesophyll.
- Specifically in thylakoids (light rxns) & stroma (light-indi rxns)

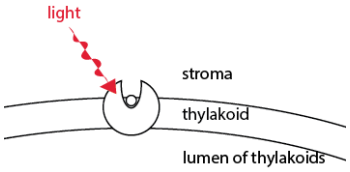




II. Process Review

B. Light Rxns

1. Photosystems



II. Process Review

B. Light Rxns

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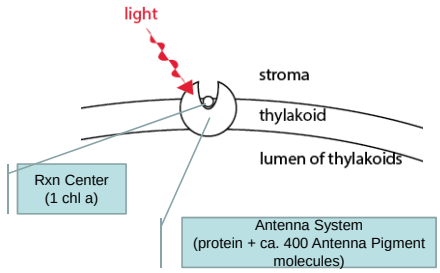
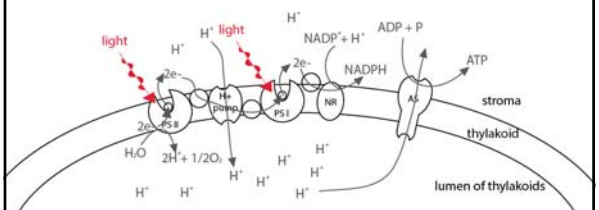


II. Process Review

B. Light Rxns

1. Photosystems
2. **Transfer of Light E to Chemical E**

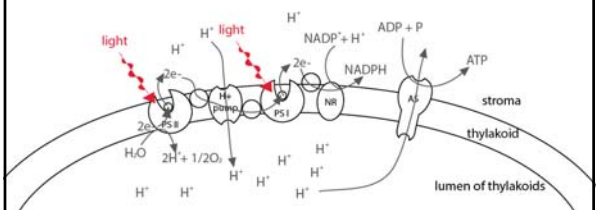


NR = NADP reductase
NADP+ = Nicotinamide adenine dinucleotide phosphate
NADPH = reduced form of NADP+

II. Process Review

B. Light Rxns

1. Photosystems
2. **Transfer of Light E to Chemical E**



II. Process Review

B. Light Rxns

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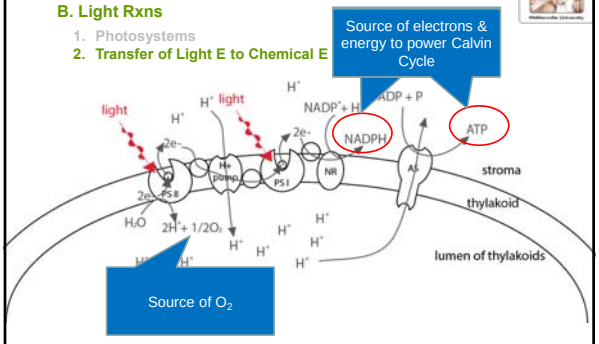
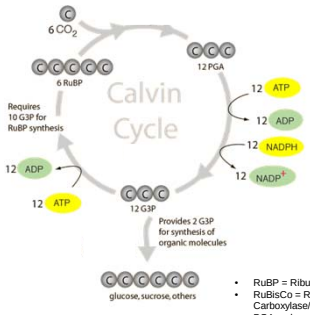


II. Process Review

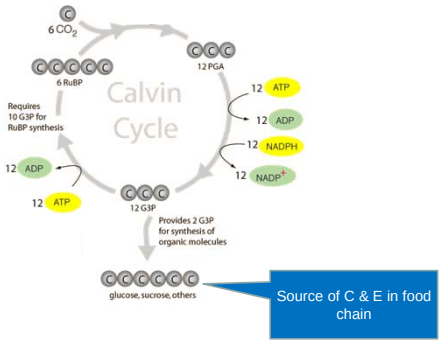
C. Calvin Cycle



- RuBP = Ribulose 1,5-bisphosphate
- RuBisCo = Ribulose-1,5-bisphosphate Carboxylase/Oxygenase
- PGA = phosphoglyceric acid
- G3P = phosphoglyceraldehyde

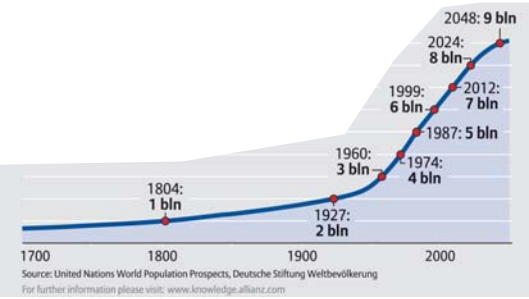
II. Process Review

C. Calvin Cycle



III. Areas of Active, Applied Research

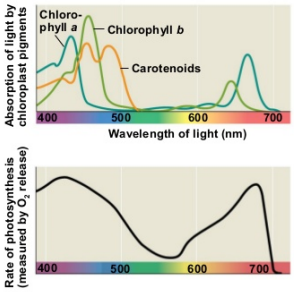
A. Feeding a Hungry World



III. Areas of Active, Applied Research

A. Feeding a Hungry World

1. Can we expand the PAS in crop plants?

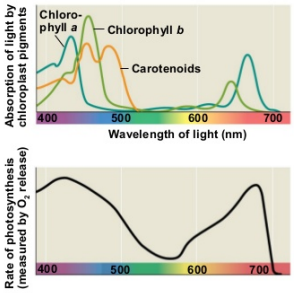


III. Areas of Active, Applied Research

A. Feeding a Hungry World

1. Can we expand the PAS in crop plants?

2. What issues would such plants (& societies) face?



III. Areas of Active, Applied Research

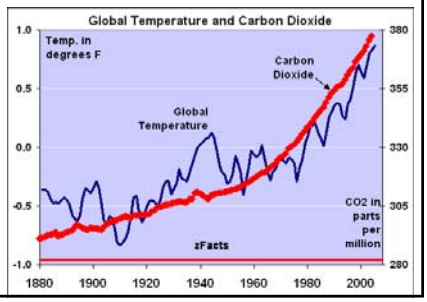
B. Mitigating Climate Change

III. Areas of Active, Applied Research

B. Mitigating Climate Change

1. Facts

a. The Earth is warming. CO_2 is a greenhouse gas.



III. Areas of Active, Applied Research

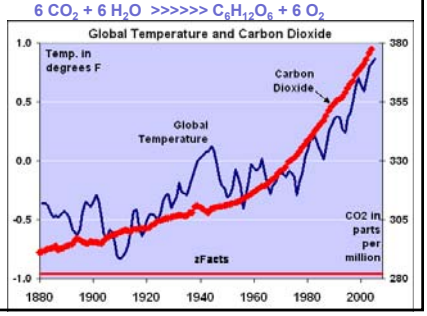
B. Mitigating Climate Change

1. Facts

a. The Earth is warming. CO_2 is a greenhouse gas.

b. Photosynthesis removes CO_2 from atmosphere.

$6\ CO_2 + 6\ H_2O$ >>>>>> $C_6H_{12}O_6 + 6\ O_2$



III. Areas of Active, Applied Research

B. Mitigating Climate Change

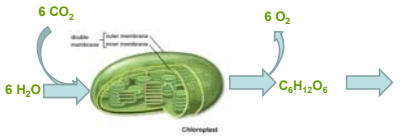
2. Storing Carbon

III. Areas of Active, Applied Research

B. Mitigating Climate Change

2. Storing Carbon

a. Plants remove CO2 from atmosphere. Store it in their bodies.



Starch
Cellulose
Amino Acids
Lipids
Pigments
Floral Fragrances
Hormones
Alkaloids
THC
Etc.

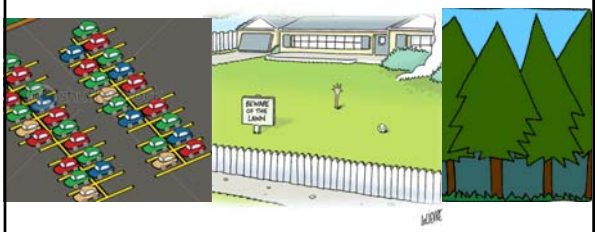
III. Areas of Active, Applied Research

B. Mitigating Climate Change

2. Storing Carbon

a. Plants remove CO2 from atmosphere. Store it in their bodies.

b. Landscapes with greater biomass store more carbon



III. Areas of Active, Applied Research

B. Mitigating Climate Change

2. Storing Carbon

a. Plants remove CO2 from atmosphere. Store it in their bodies.

b. Landscapes with greater biomass store more carbon

c. Could algae be used to remove CO_2 from atmosphere?

1) Algal Farms positioned near river deltas to exploit nutrient-rich waters that could otherwise cause Dead Zones.

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2) Collect algae before they die and are decomposed and could cause Dead Zones

III. Areas of Active, Applied Research

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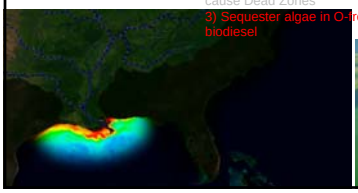
1) Algal Farms positioned near river deltas to exploit nutrient-rich waters that could otherwise cause Dead Zones.

2) Collect algae before they die and are decomposed and could cause Dead Zones

3) Sequester algae in O-free "land fills" or use to make biodiesel



III. Areas of Active, Applied Research

B. Mitigating Climate Change

2. Storing Carbon

3. C-neutral biofuels

a. Keep fossil fuels in the ground

b. Grow plants/algae and convert to ethanol or biodiesel

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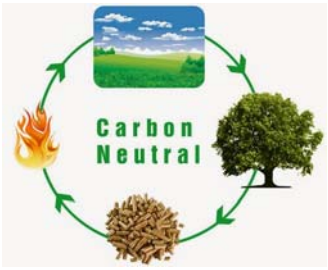

Topic Done.