

Let's Compare...

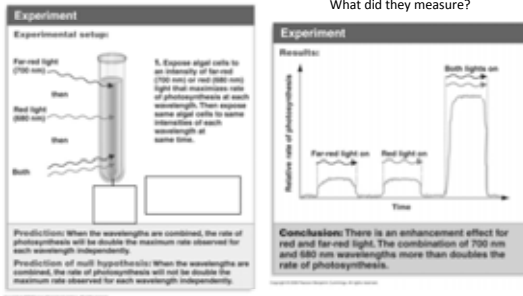
	Photosystem II	Photosystem I
Production	[Redacted]	[Redacted]
Wavelength	[Redacted]	[Redacted]

They can work alone, but work so much better together

How do they know that??

Do some Science!

What did they measure?



From the book...

Fig 10.12 pg. 207

Z-scheme

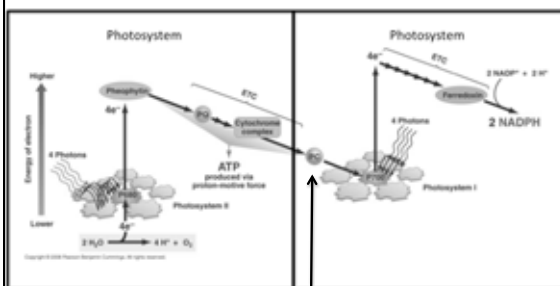
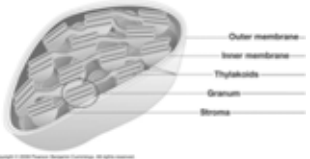


Fig 10.15 pg. 211

Calvin Cycle

All reactions located in the stroma
Light independent

(B) Chloroplasts are highly structured, membrane-rich organelles.



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Fig. 10.2 pg. 200

Calvin Cycle

ATP + NADPH + CO₂ → CH₂O
? ? XXXXXXXXXX

3 phases

1. Fixation
2. Reduction
3. Regeneration

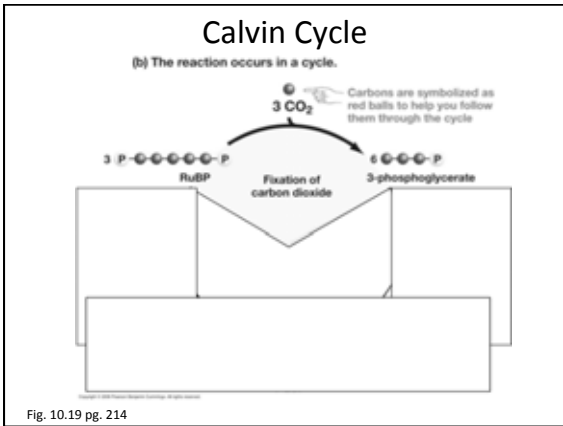
Calvin Cycle
Fixation

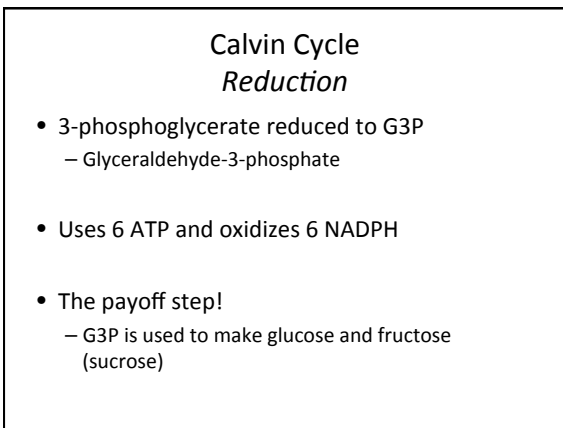
Fixes CO₂ from atmosphere to form a 6-carbon molecule

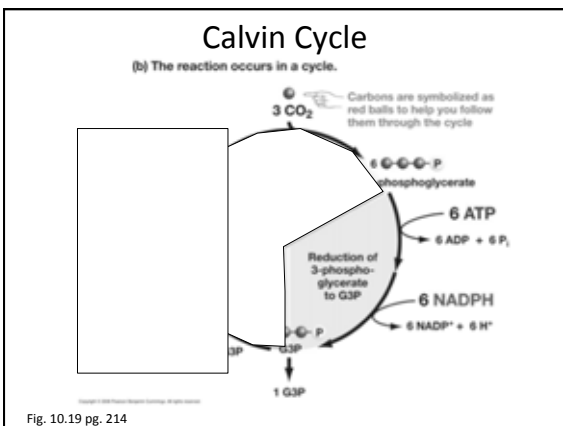
Not CO₂ + CO₂ + CO₂ + CO₂ + CO₂ + CO₂

CO₂ connected to a 5-carbon molecule called Ribulose biphosphate (RuBP) ☺

Final Product: 3-phosphoglycerate

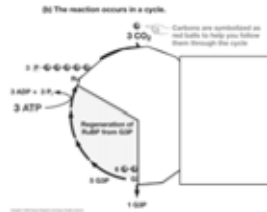






Calvin Cycle Regeneration

- Adds 2 more carbon atoms to become RuBP again
- Uses 3 ATP



Calvin Cycle

(b) The reaction occurs in a cycle.

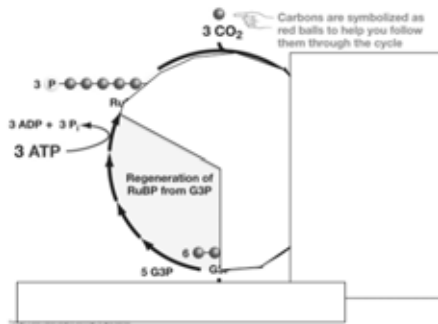


Fig. 10.19 pg. 214

Calvin Cycle

(b) The reaction occurs in a cycle.

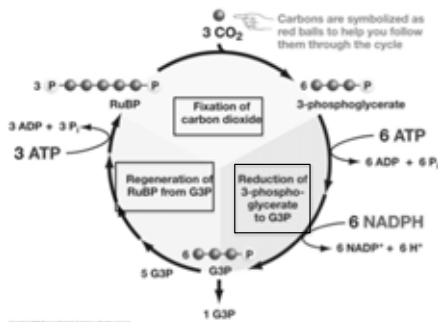


Fig. 10.19 pg. 214

Question

- Where is the Calvin cycle located in the Eukaryotic cell?
[REDACTED]
- Which product of the Calvin cycle is used to create sugars?
[REDACTED]

Calvin Cycle

And costs no ATP!

1. Fixation
 - Fixes CO₂ with RuBP to make 3-phosphoglycerate
2. Reduction*
 - 3-phosphoglycerate reduces to G3P
 - G3P used to make sugars
3. Regeneration*
 - G3P recombined to make RuBP

Calvin Cycle

Rubisco: an enzyme's tale

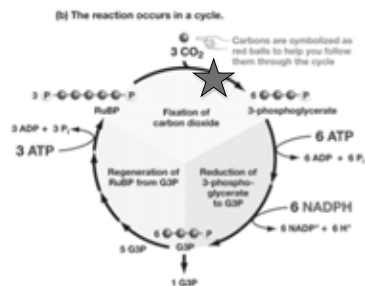



Fig. 10.19 pg. 214

Rubisco

- Ribulose-1,5-bisphosphate carboxylase/oxygenase
- Enzyme responsible for CO₂ fixation
- Cube shaped (8 active sites)

RuBisCO
(Ribulose-1,5-bisphosphate carboxylase oxygenase)

- Most abundant protein on earth
- Crucial for carbon fixation
- Source of energy for all heterotrophs



Large chain dimers (white and grey)

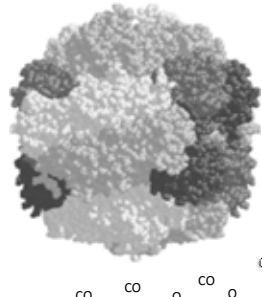
Small chains (blue and orange)

Wanted poster on a chloroplast:

RuBisCO gene stolen from owner. If seen, please contact the green prokaryote

<http://www.growingseason.org/2010/04/evolution-of-chloroplasts-endosymbiosis.html>

Rubisco




- Slow, inefficient
 - Only 3 reactions/sec
 - O₂ competes with CO₂
- Reactions with O₂ results in a reaction that undoes photosynthesis
 - CO₂ – Splits carbon and uses ATP

<http://en.wikipedia.org/wiki/RuBisCO>

Rubisco

- Maladaptive!
 - Reduces fitness
- How could this be?
 - Hypothesis: it was present before massive amounts of O₂ were present in the atmosphere
 - Prediction: If rubisco had evolved after O₂ was present, then it would have developed a more specific binding site for CO₂ to avoid competition with O₂

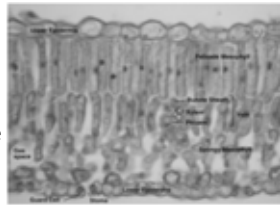


<http://en.wikipedia.org/wiki/RuBisCO>

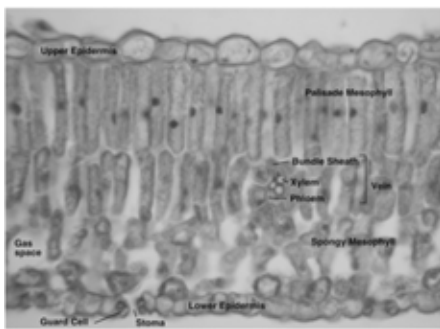
What adaptations have come about to increase the efficiency of rubisco?

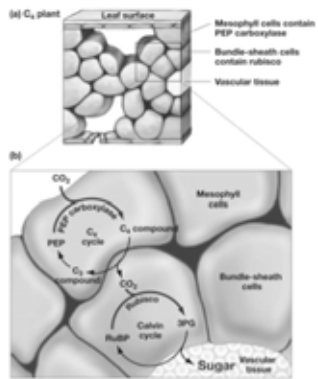
C Photosynthesis

- Product of fixation – 4-carbon molecule
- CO₂ fixed in mesophyll
- Rubisco only in bundle sheath cells



C₄ Photosynthesis





Fl. 10.23 PG. 217

Questions

- C and CAM photosynthesis are two ways to circumvent the inefficiencies of what enzyme?

██████████

- What makes Rubisco inefficient?

████████████████████
