Chapter 10 Notes

When light strikes an object, it can either be absorbed, transmitted, or reflected.

Plant pigments

Most important for photosynthesis: Chl. a and b - absorb red + blue, reflect green

Accessory (or antennae) pigments: Carotenes, xanthophylls, anthocyanin - these gather in other light wavelengths and make photosynthesis more efficient.

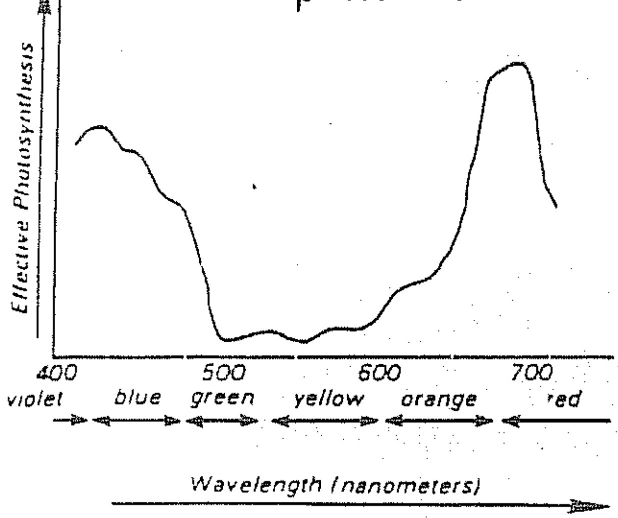
Role of pigments

When light hits a pigment, certain wavelengths are absorbed and the energy boosts an electron to a higher energy level (higher potential energy).

The excited electron can do several things:

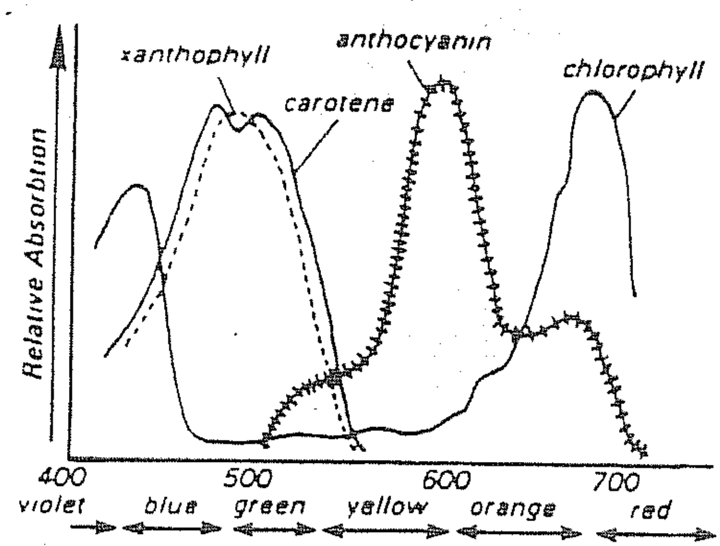
1) drop back to ground state emitting heat
2) drop back to ground state emitting light and heat = fluorescence
3) excited pigment can pass off its energy (or e-) to nearby molecule. This occurs in intact chloroplasts

Action Spectrum

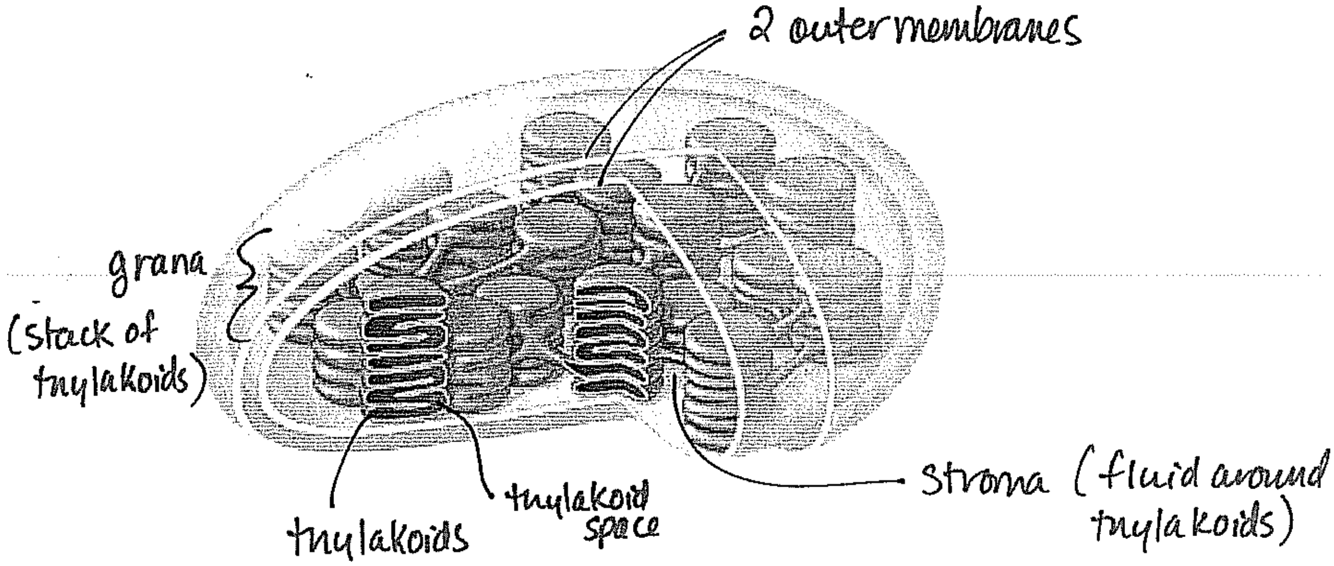


Action spectrum for photosynthesis in green plants.

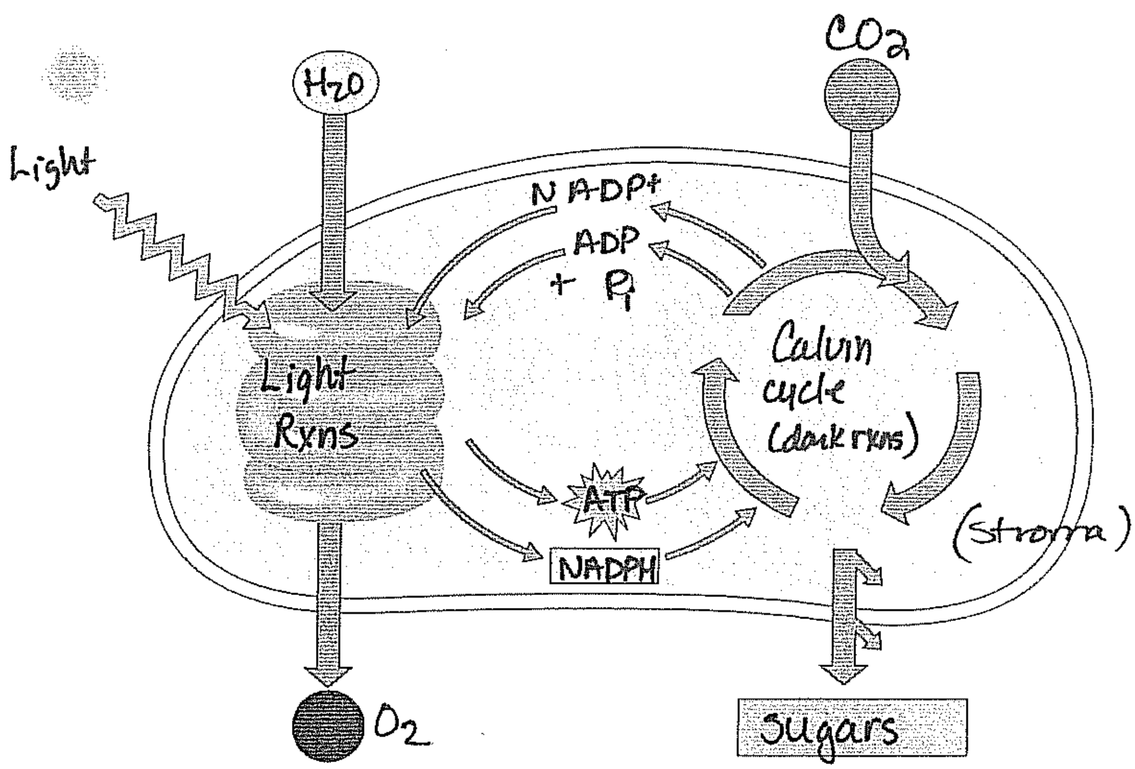
Absorption spectrum



Chloroplast Structure



Overview of Photosynthesis

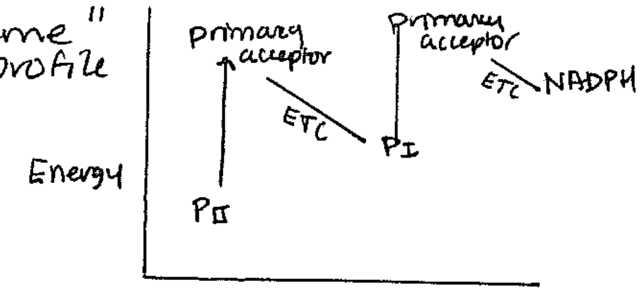


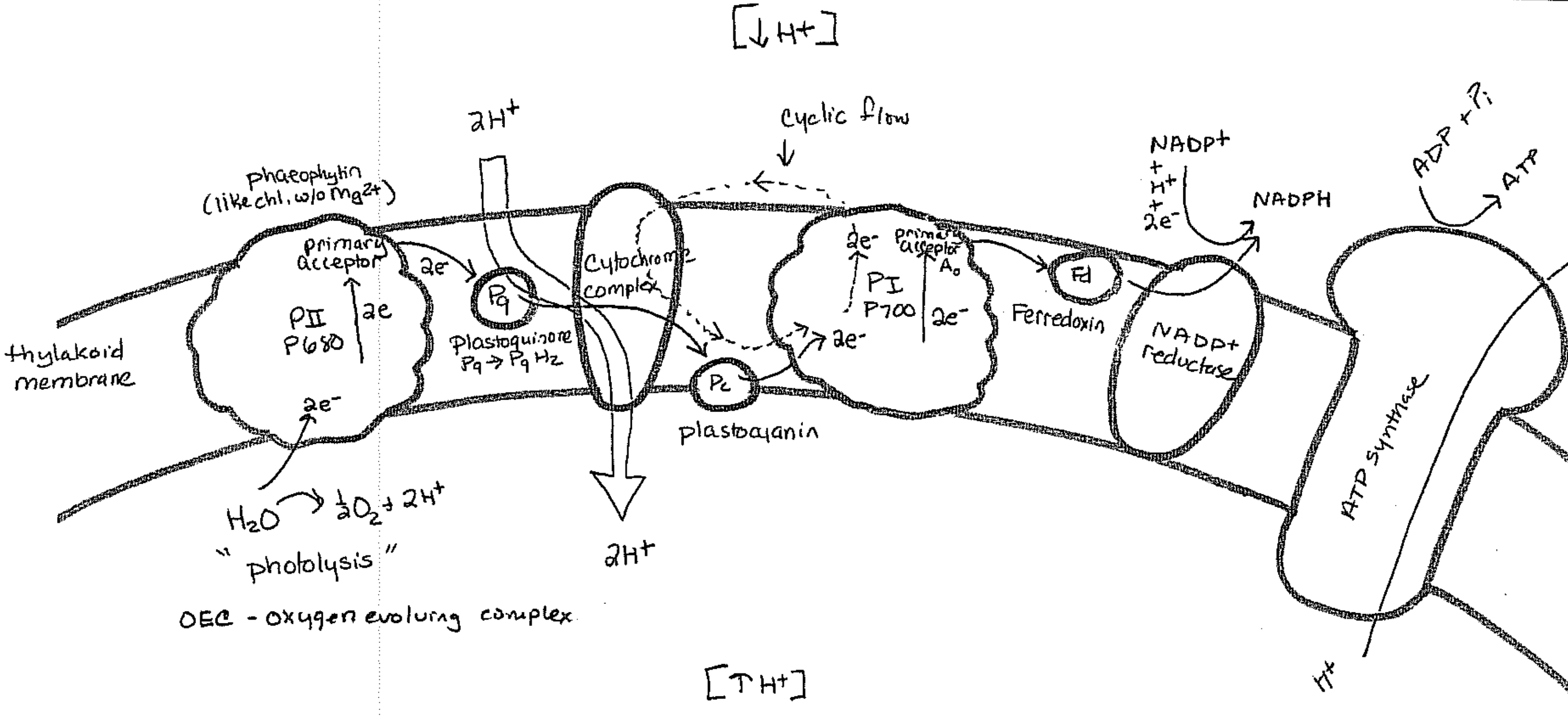
Light Reactions

Overall equation

$$2H_2O + 2NADP^+ \rightarrow O_2 + 2NADPH$$

"Z-scheme" energy profile of e⁻





Photosystem I + II

clusters of many antennae pigments w/ a special "reaction center" (2 chl a and a primary acceptor) that boosts two e⁻ and passes them off to the primary acceptor.

P680 - best absorbs light at 680 nm
P700

Non-cyclic e⁻ flow

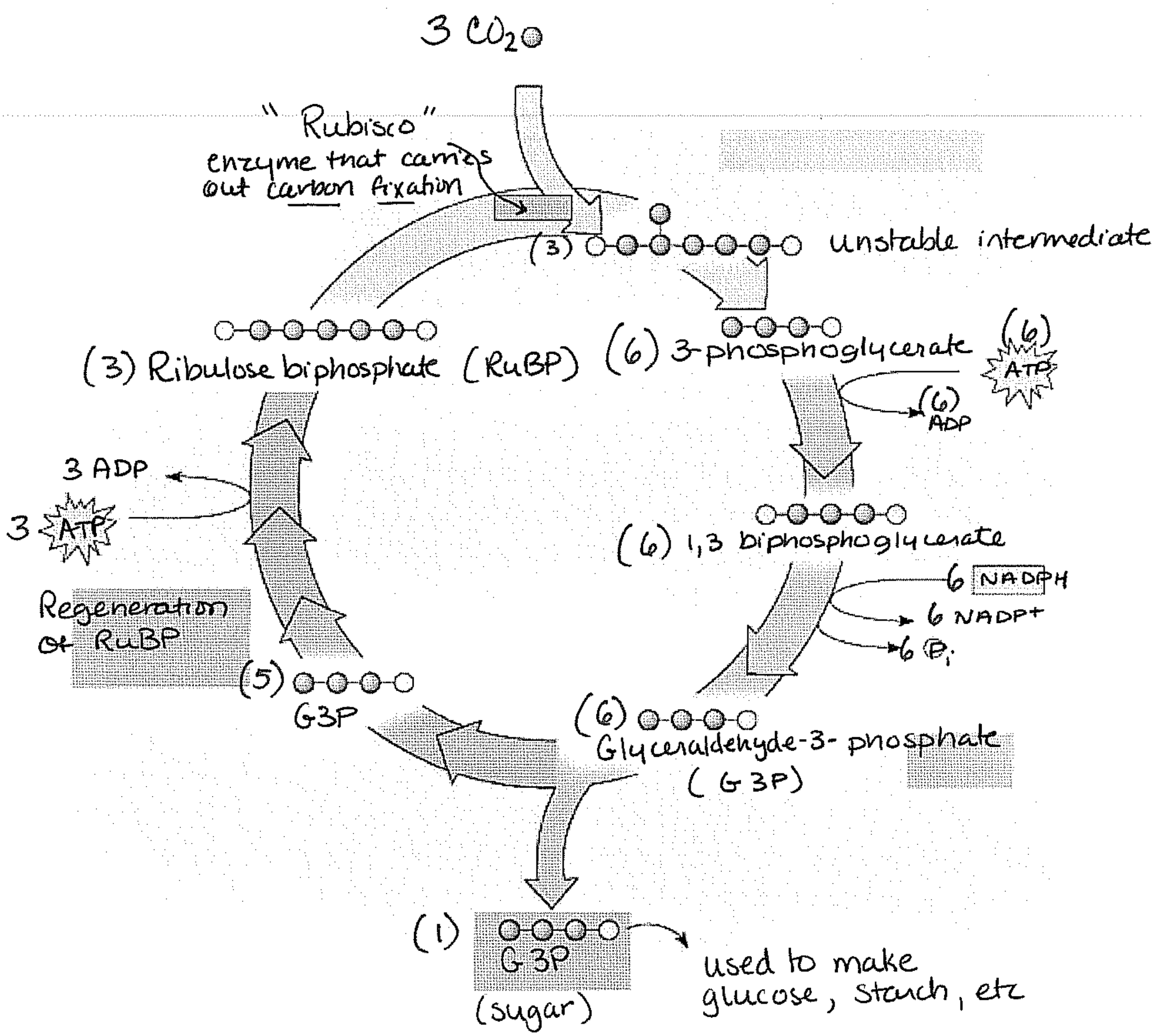
e⁻ move from H_2O to NADPH; ATP is generated

Cyclic flow

e⁻ moved from PI to primary acceptor back to cytochrome complex + returns to PI. Addition ATP is generated.

The Calvin Cycle takes place in the stroma

(O= carbon atoms)



Review light reaction
- show ΔG profile on the board (predict?) for energy profile of e- (Z scheme)

3) Do Q.

Review Questions

1. Non-cyclic path of electrons: H_2O → PII → PI → NADPH (stroma)

2. Cyclic path of electrons: P700 → Cytochrome complex → P700

3.

Compare:	Chloroplast	Mitochondria
High H^+ concentration	thylakoid space	inner mem. space
First e- donor	H_2O ($\rightarrow O_2$)	NADH, $FADH_2$
Final e- acceptor	NADP+	O_2 ($\rightarrow H_2O$)
ATP synthase moves H^+ from where to where	thy. space to stroma	inner mem space → matrix

4. Name ~~X~~ 3 uses for the proton pump in plants:
   - accumulation of minerals in root
   -
   - sucrose loading (translocation)

5. Name 3 things that pass through the stomata: H_2O, CO_2 and O_2

6. What happens to O_2/CO_2 levels on a very hot dry day? in leaf?

Stomata close { CO_2 gets used up by Calvin cycle – no new CO_2 enters; O_2 build up in leaf – can't escape }

Photorespiration and C3/C4 Plants

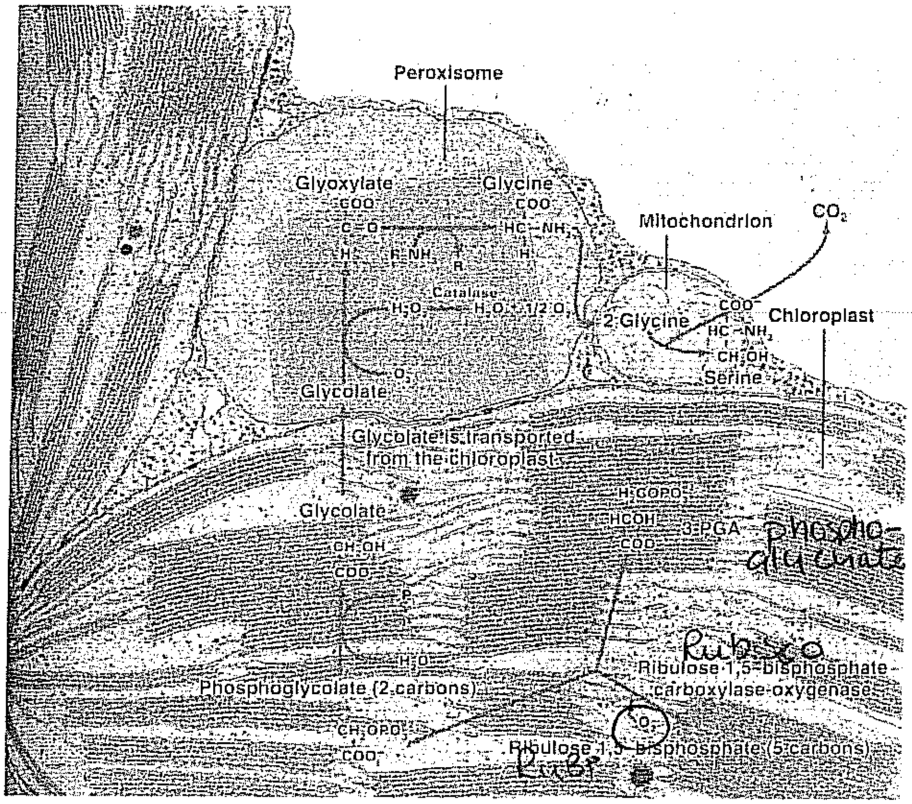
C3 plants (soybeans): the first stable product following carbon fixation has 3 carbons. (phosphoglycerate)

Rubisco's active site can bind to either CO_2 or O_2.

If it binds to CO_2, the Calvin cycle and carbohydrate production begins yeah!

If it binds to O_2, photorespiration, a wasteful process begins. boo!

- CO_2 in atm = 380 ppm
- if CO_2 levels drop to 50 ppm photoresp loses as much CO_2 as photosynth. fixes.
- How could it drop this low???



O_2 "Rubiso"

RuBP → 1 phosphoglycerate + phosphoglycolate

phosphoglycolate → (peroxiso) → glucine → (to mitoch.) → Serine + CO_2 = wastefull

Two Adaptations to Avoid Photorespiration

C4 Plants (sugar cane and corn): First stable product following carbon fixation has _______ carbons.

(OMPP)

still producing sugar at 1-2 ppm CO_2

mesophyll cells: CO_2 (PEP carboxylase enzyme) + PEP → Oxaloacetate → malate → pyruvate → PEP (ATP → ADP)

Bundle Sheath cells (away from air pockets): malate → CO_2 → Calvin cycle

CAM Plants (cacti and succulents): open stomata and fix carbon at night.

(I believe it is still OMPP)

night: CO_2 (PEP carboxylase) → malate stored in vacuole

Day: malate → CO_2