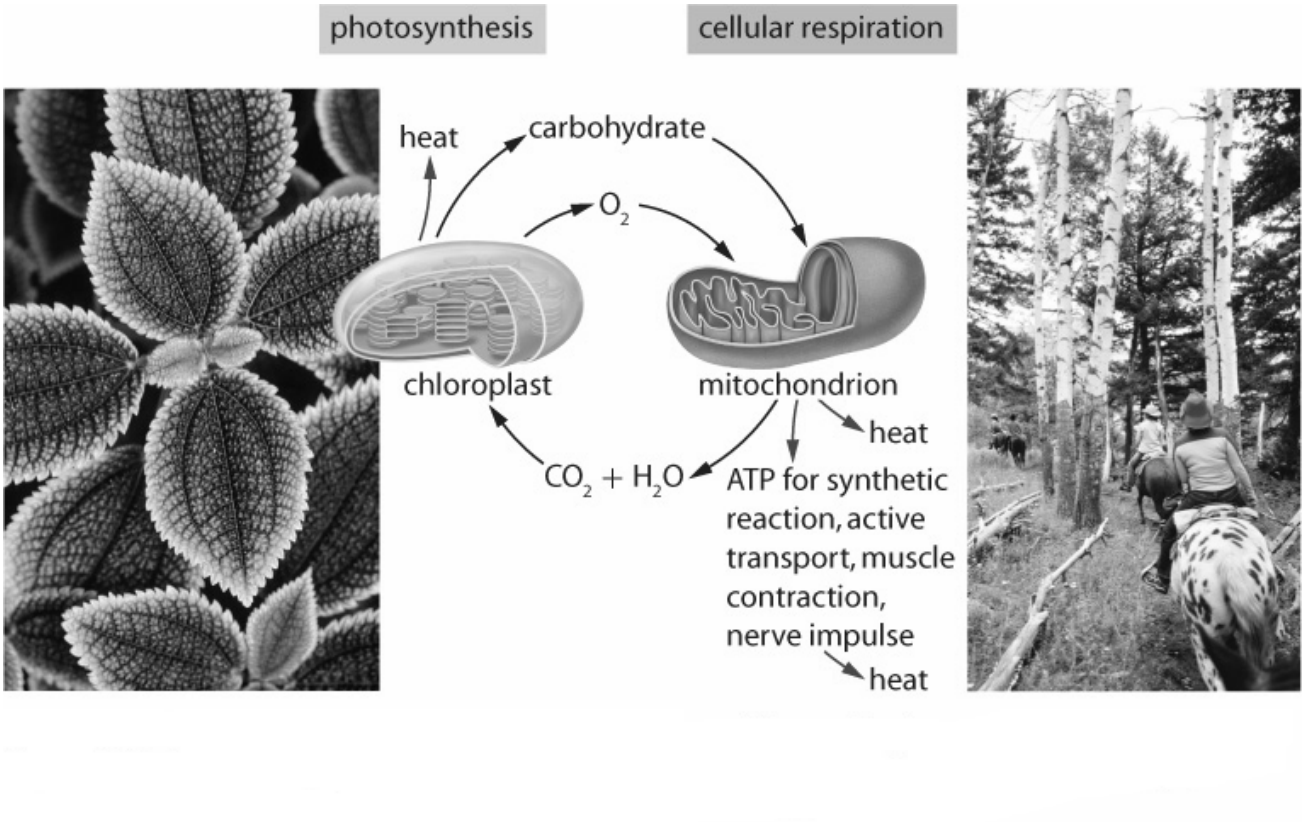
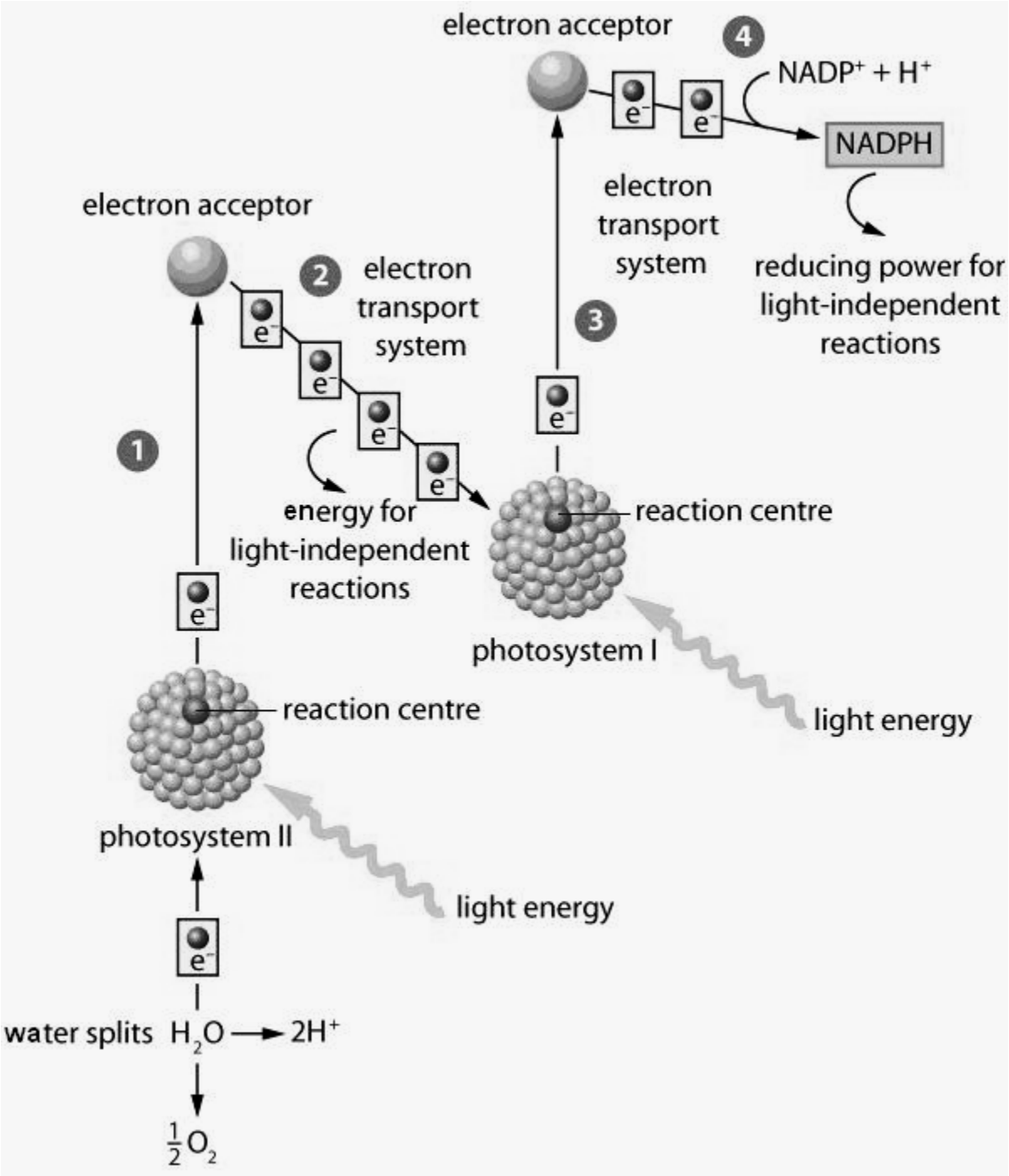
Review of major concepts covered in photosynthesis and Cellular Respiration

Trapping and Using the Sun's Energy



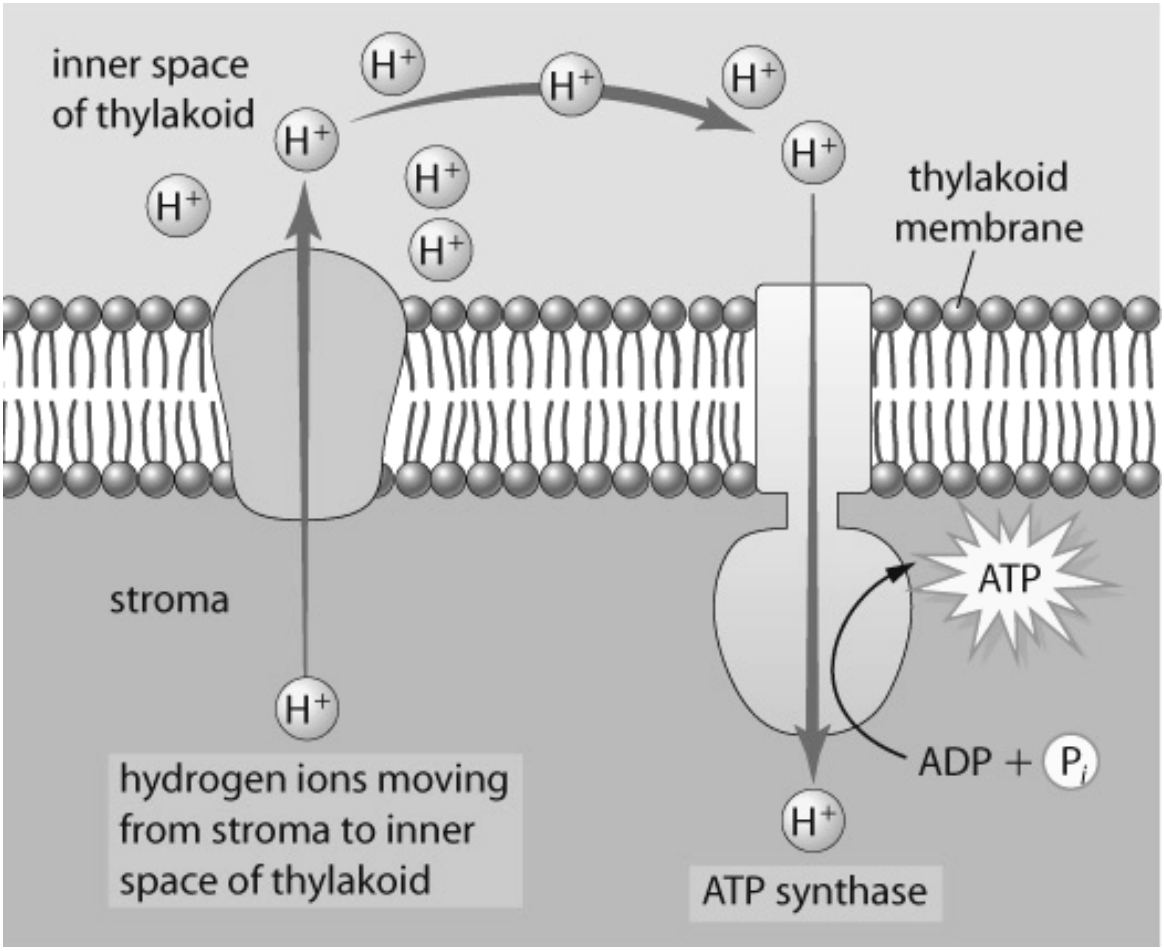
Chloroplasts trap the Sun's energy and use it to synthesize energy-rich compounds. Animals either eat the plants or other plant-eating animals. These consumers then use the stored, energy-rich compounds to generate ATP to fuel all life functions.

The Light-Dependent Reactions of Photosynthesis



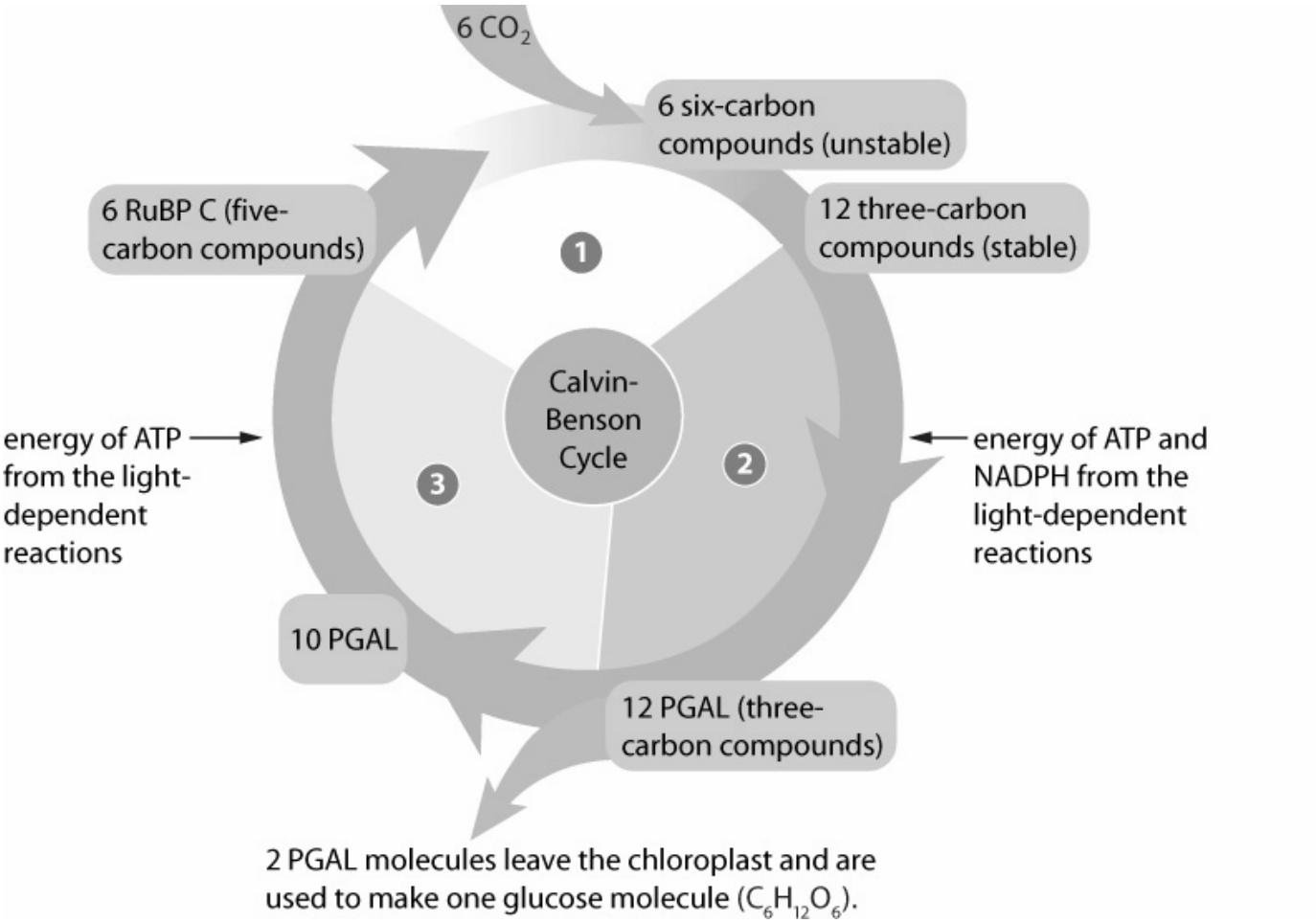
A summary of the light-dependent reactions of photosynthesis, which take place in the thylakoid membranes of the chloroplast

Chemiosmosis in a Chloroplast



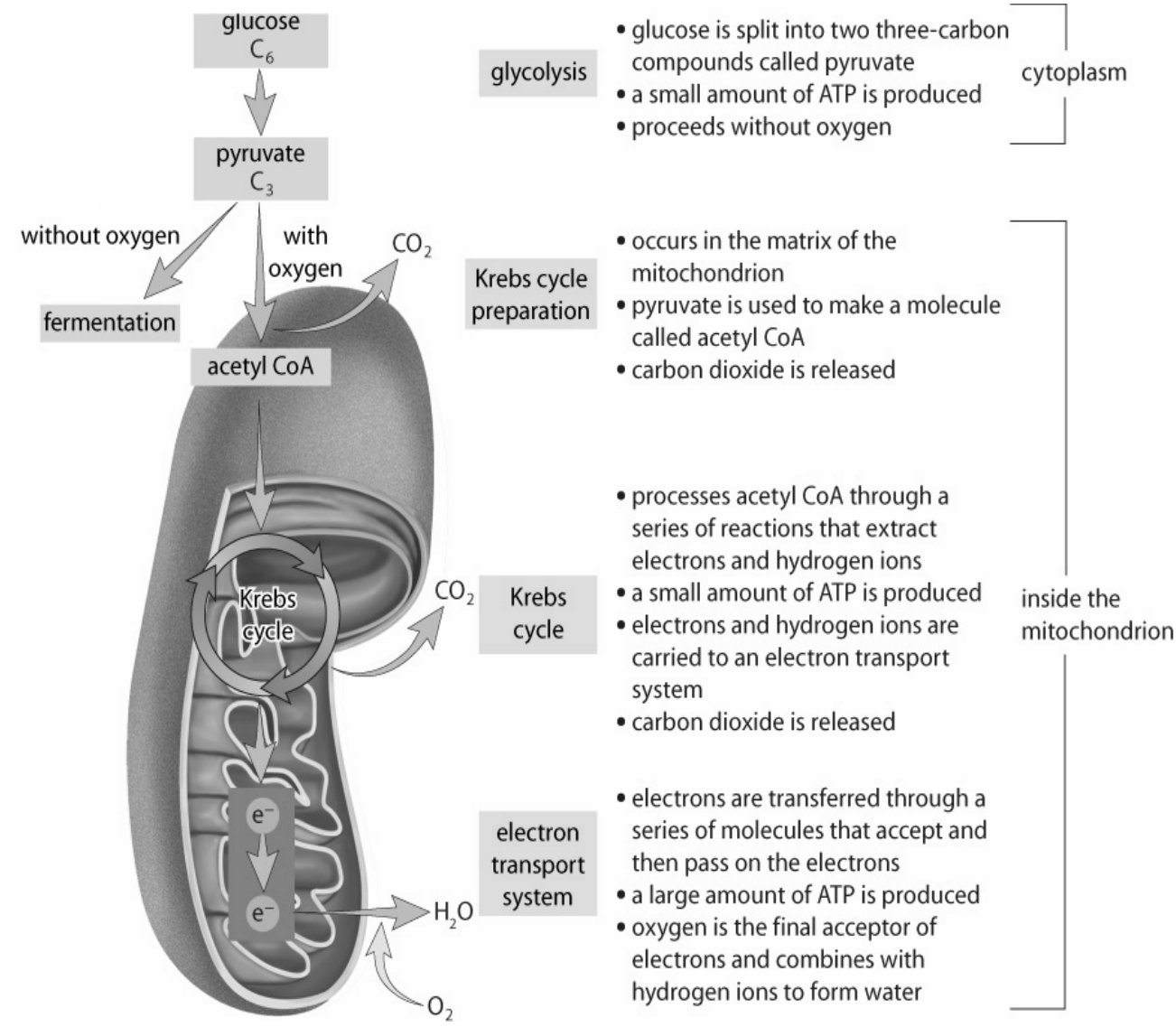
Think of the hydrogen ions passing through the ATP synthase as being like water passing through a dam. Just as the water turns a turbine that generates electrical energy, the movement of hydrogen ions through ATP synthase "turns a molecular turbine" that generates ATP.

The Calvin-Benson Cycle
(or light-independent reactions)



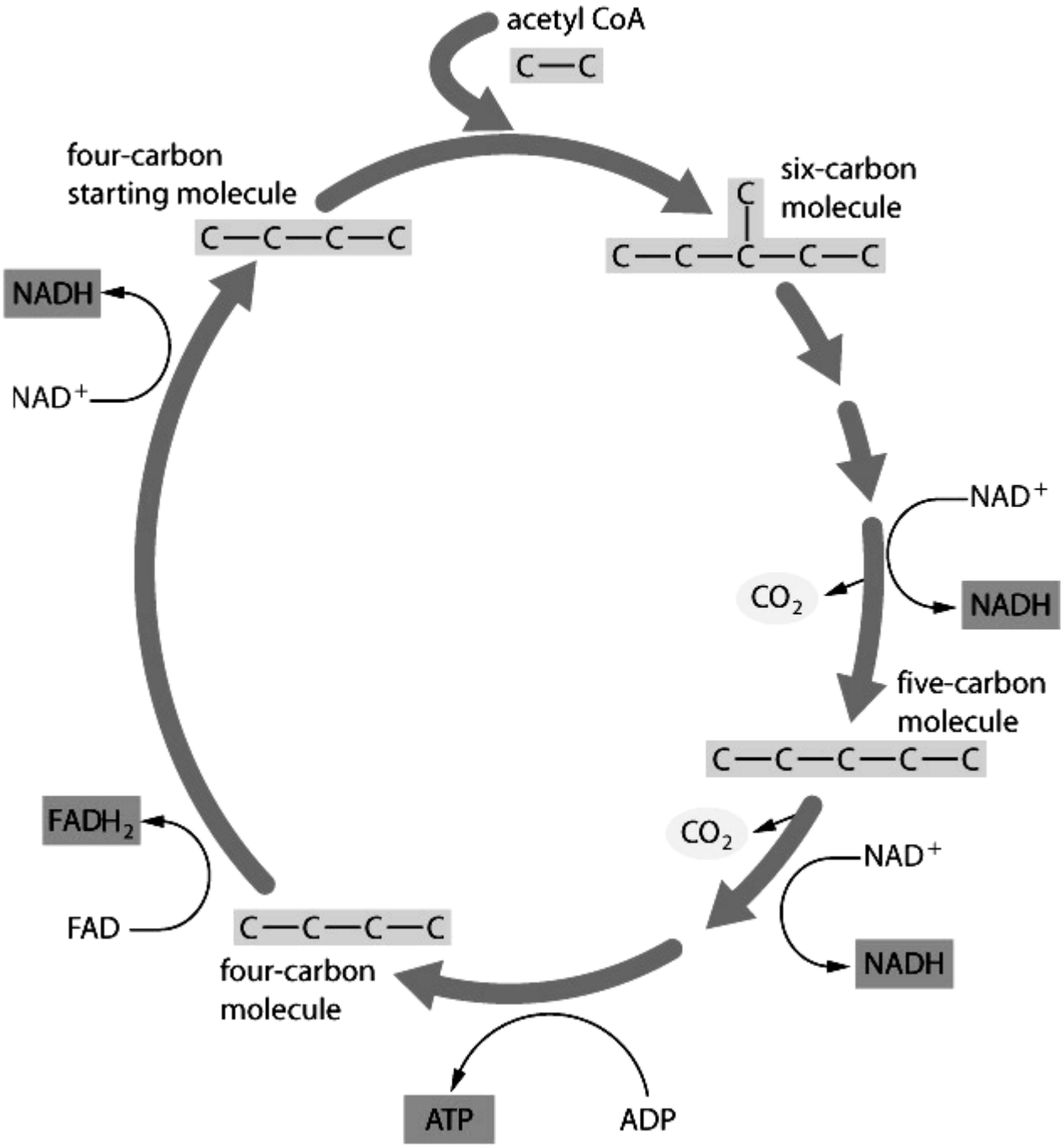
For every 12 PGAL molecules that are synthesized in the Calvin-Benson cycle, two leave the chloroplasts and go into the cytoplasm. There, they are used to make glucose and other high-energy compounds.

Stages of Cellular Respiration



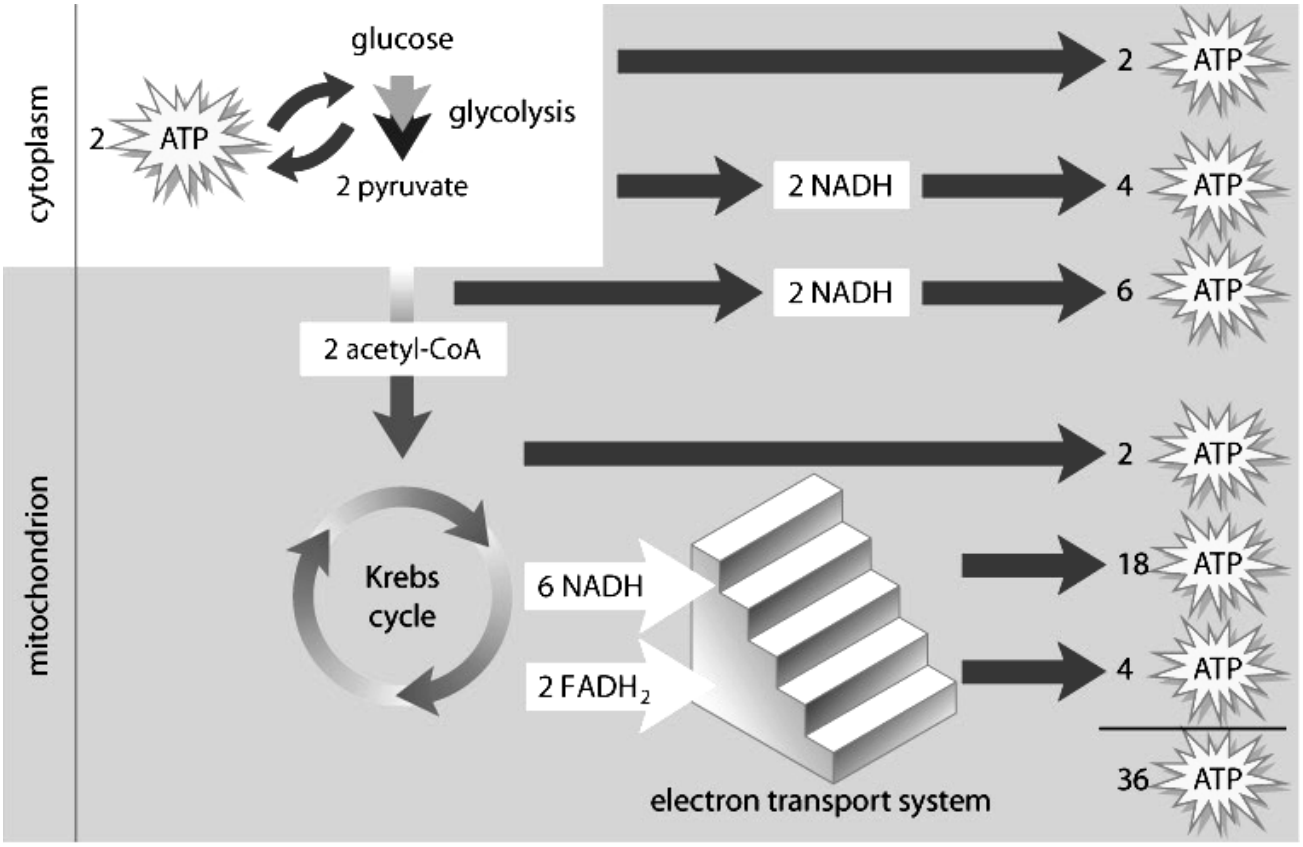
Aerobic cellular respiration includes four main stages: glycolysis, Krebs cycle preparation, Krebs cycle, and an electron transport system.

The Krebs Cycle



The role of the Krebs cycle is to transfer the energy that was originally stored in glucose to the reducing power of NADH and $FADH_2$.

Aerobic Cellular Respiration



In aerobic cellular respiration, only a small amount of ATP is generated by glycolysis, and only a small amount of ATP is generated by the Krebs cycle. The majority of the ATP is generated by chemiosmosis using energy generated via the electron transport system.

Flow of Energy Between Photosynthesis and Cellular Respiration

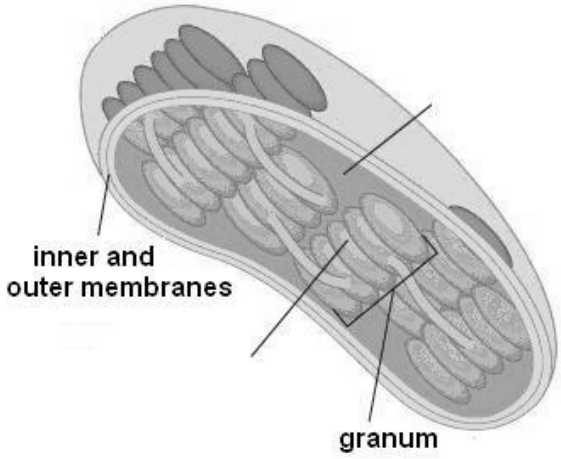
1. Complete the chart below to identify the basic steps for photosynthesis and cellular respiration.

The Energy Processes

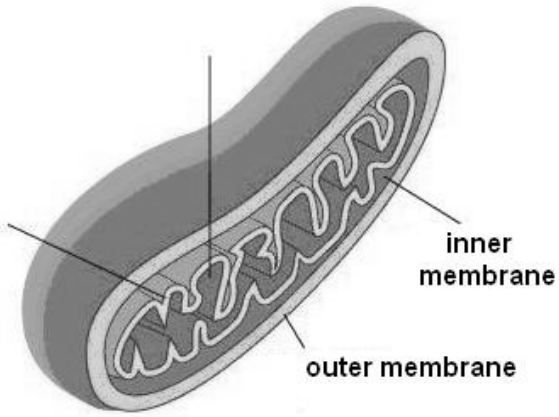
Photosynthesis			Cellular Respiration		
Energy Used or Released	**Reactions**	**Location**	**Energy Used or Released**	**Reactions**	**Location**
Light energy captured	Water splits, forms oxygen; NADP reduced to form NADPH			Glycolysis	
	Chemi-osmosis			Pyruvate is used to make acetyl CoA	
	Synthesis of PGAL			Krebs cycle	
	Synthesis of RuBP from PGAL		Many ATP produced using energy from proton gradient	Chemi-osmosis	

2. Add the following labels to the diagrams of the mitochondrion and the chloroplast on the next page. Some labels may be used more than once.

Labels:
ATP
Calvin-Benson cycle
carbon dioxide
cristae
cytoplasm
glucose synthesis
glycolysis
Krebs cycle
light energy
matrix
oxygen
PGAL
pyruvate
stroma
thylakoid



cytoplasm



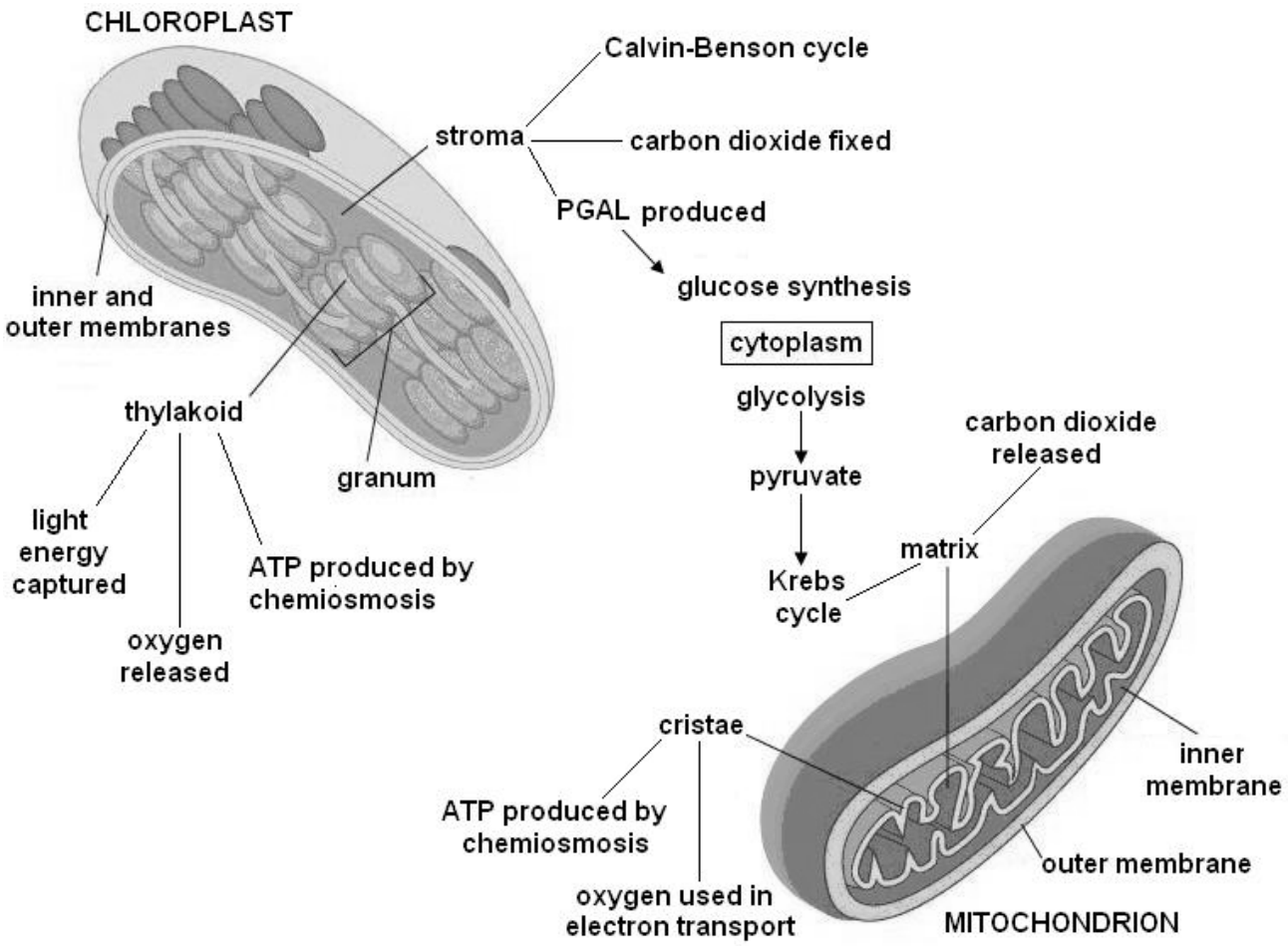
3. Make a detailed flow chart showing the flow of energy between photosynthesis and cellular respiration.

1.

The Energy Processes

Photosynthesis			Cellular Respiration		
Energy Used or Released	**Reactions**	**Location**	**Energy Used or Released**	**Reactions**	**Location**
Light energy captured	Water splits, forms oxygen; NADP reduced to form NADPH	Thylakoid membrane	Small amount of ATP produced	Glycolysis	Cytoplasm
Energy stored in proton gradient used to synthesize ATP	Chemi-osmosis	Thylakoid membrane	Energy used to reduce NAD to NADH	Pyruvate is used to make acetyl CoA	Matrix
ATP and NADPH from light-dependent reactions used	Synthesis of PGAL	Stroma	Small amount of ATP produced; Large amount of NAD reduced to NADH	Krebs cycle	Matrix
ATP from the light-dependent reactions used	Synthesis of RuBP from PGAL	Stroma	Many ATP produced using energy from proton gradient	Chemi-osmosis	Inner membrane

2. Diagrams should resemble the following:



3. The flow chart should resemble the following:
light energy absorbed by thylakoid membranes → used to make ATP and NADPH (light reactions of photosynthesis) → energy from ATP and NADPH used to fix CO_2 (from Krebs cycle) and form PGAL (Calvin-Benson cycle) → PGAL used to make glucose (energy storage) → glucose broken down to form pyruvate (glycolysis) → pyruvate broken down into CO_2 and acetyl CoA in matrix→ acetyl CoA enters Krebs cycle → used to make NADH → NADH from Krebs cycle and O_2 from light reactions of photosynthesis used in electron transport to create proton gradient across inner membrane → proton gradient used to make ATP (chemiosmosis) → ATP used to power cellular functions