

Cellular Respiration

Converting and using energy



When someone “loses” fat, where does it go?

BEFORE



AFTER



Think:

- What elements make up fat?**
- Can matter be created or destroyed?**

Where does fat go when it is burned?

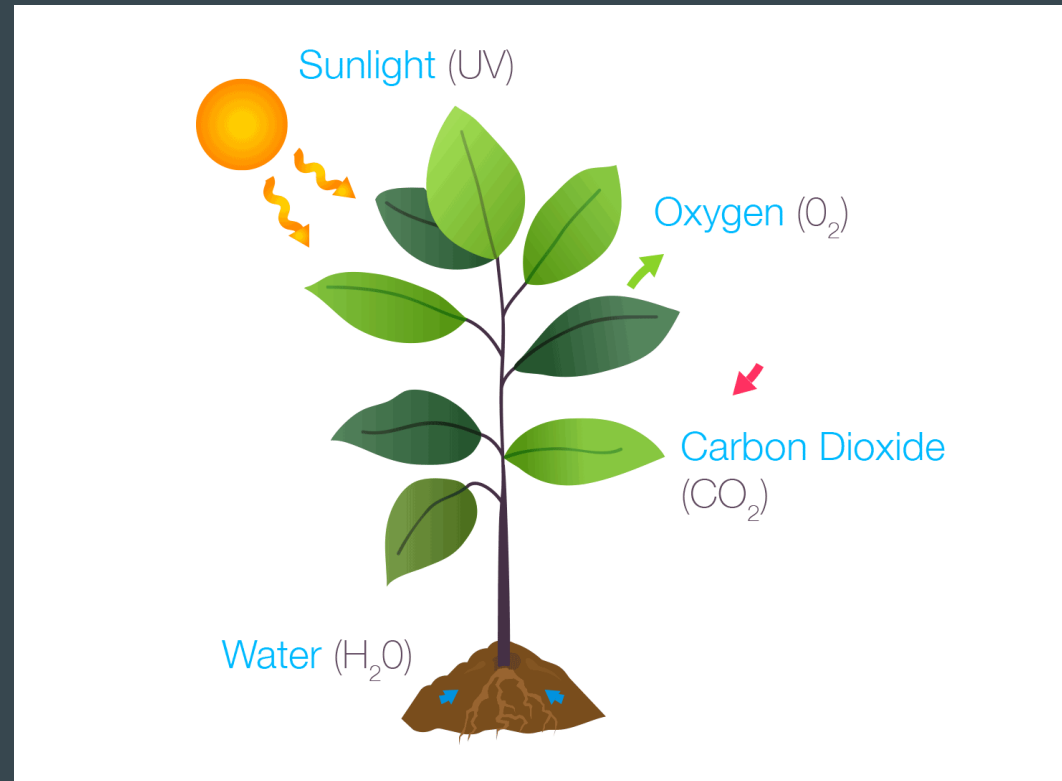


It is exhaled out!

As CO_2 and H_2O

Photosynthesis Review

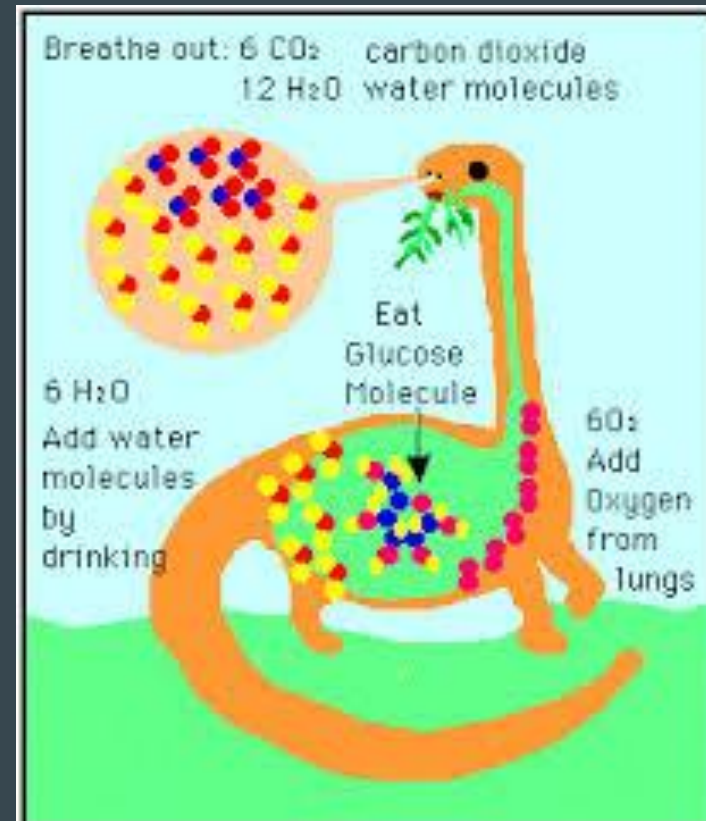
- ▶ Photosynthesis stored energy in the form of glucose.
 - Glucose is what animals and plants use to store energy.
- ▶ But ATP is the usable energy in a cell...not glucose. So...



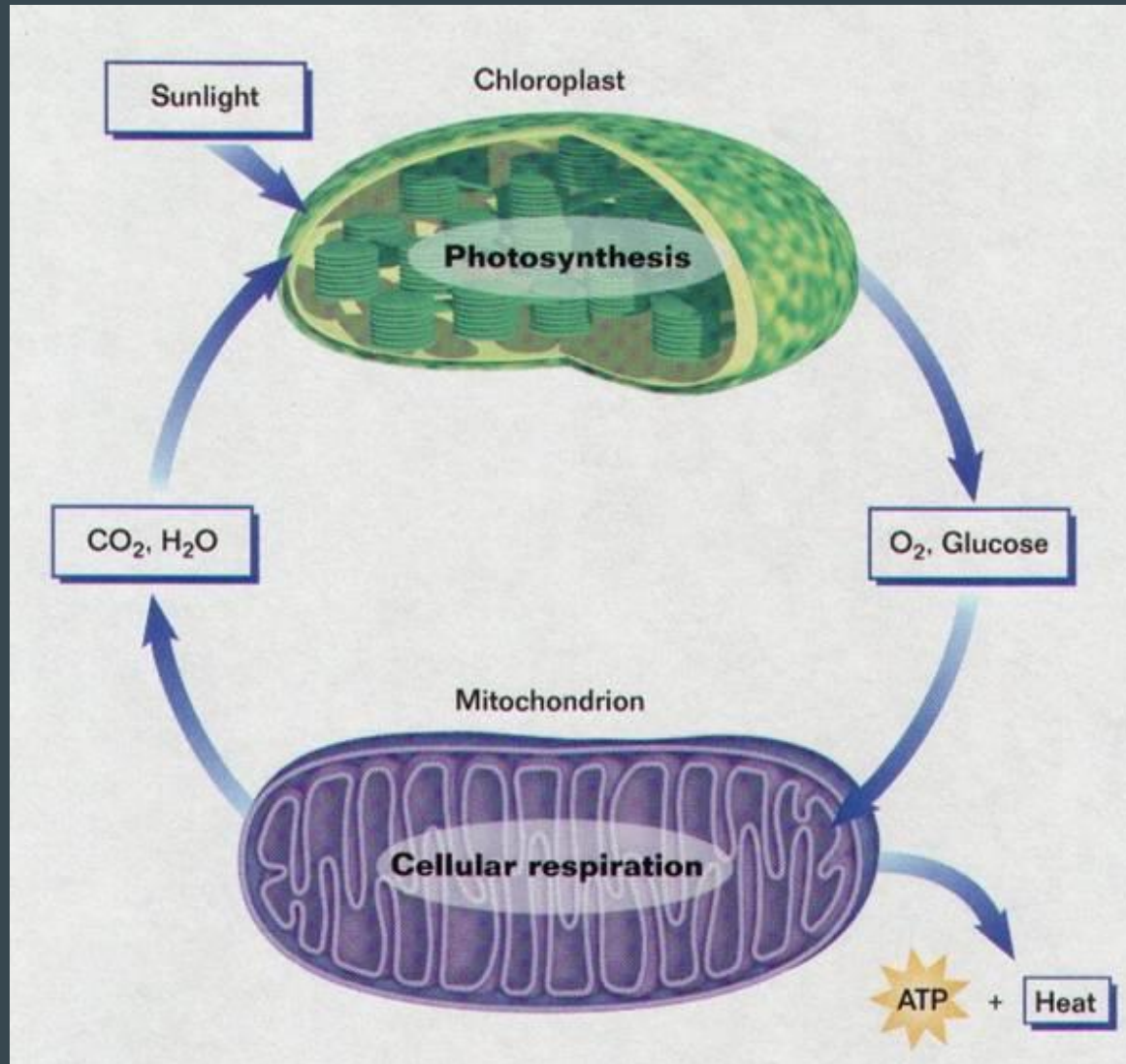
Respiration: What is it?

► Essentially cellular respiration breaks food particles (glucose) down into ATP.

- ATP is the form of energy that cells can use.
- Respiration provides all living things with the energy they need.
- This is aerobic respiration, which requires oxygen.

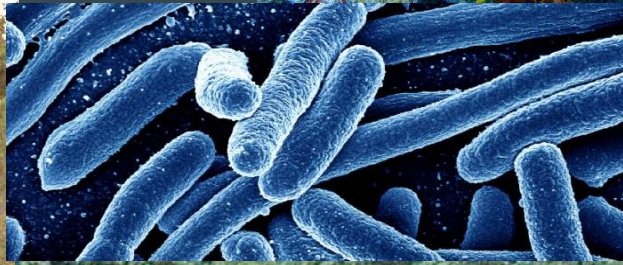


Respiration: What is it?



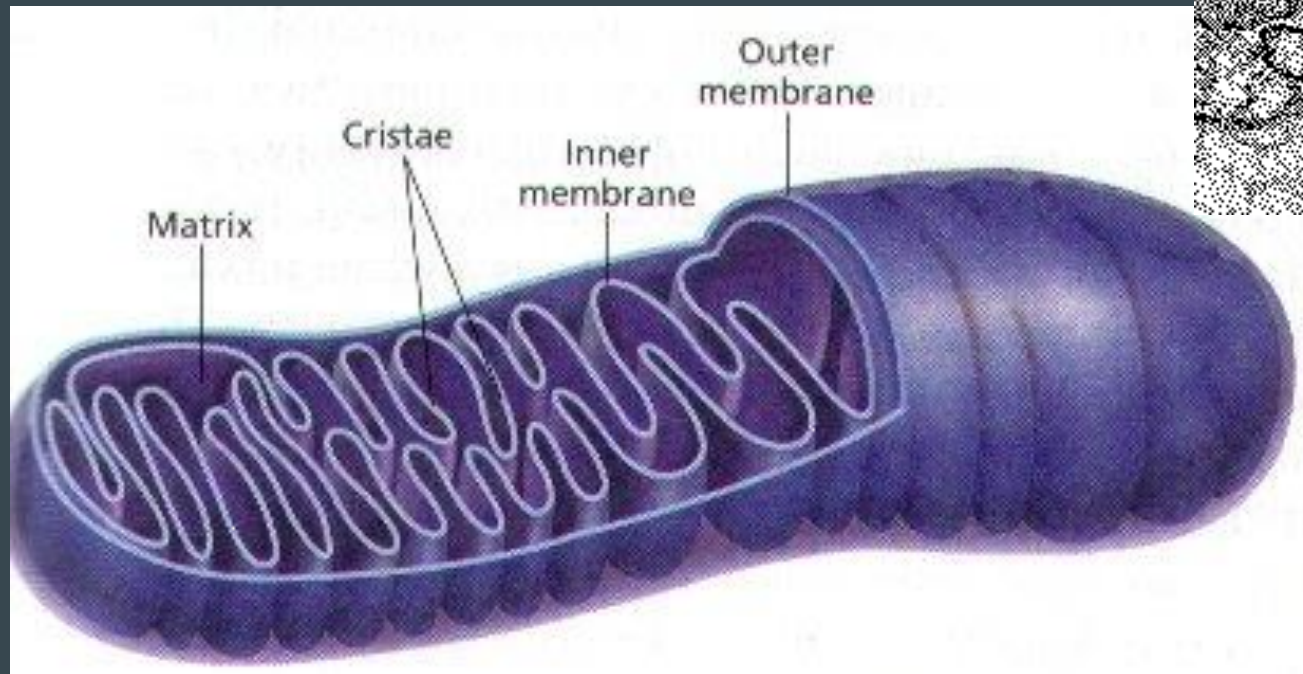
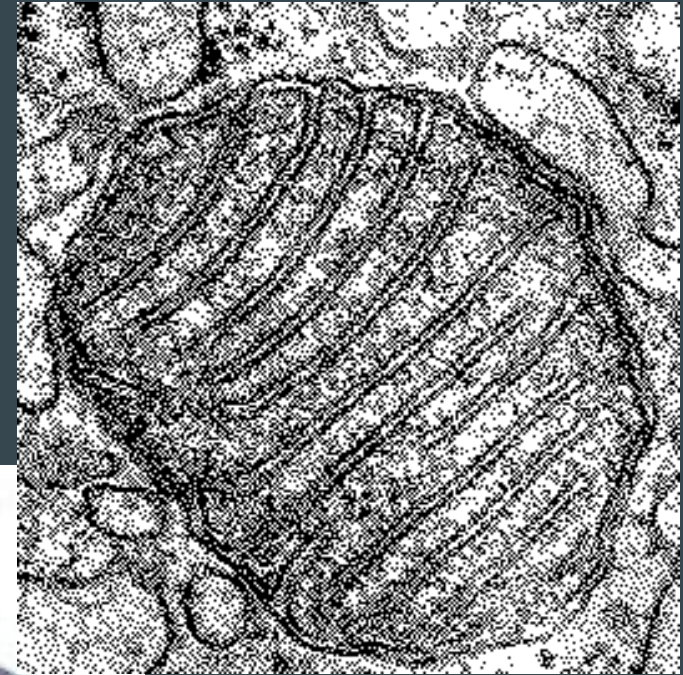
Respiration: Who does it?

- All living things do cellular respiration ...*including plants.*



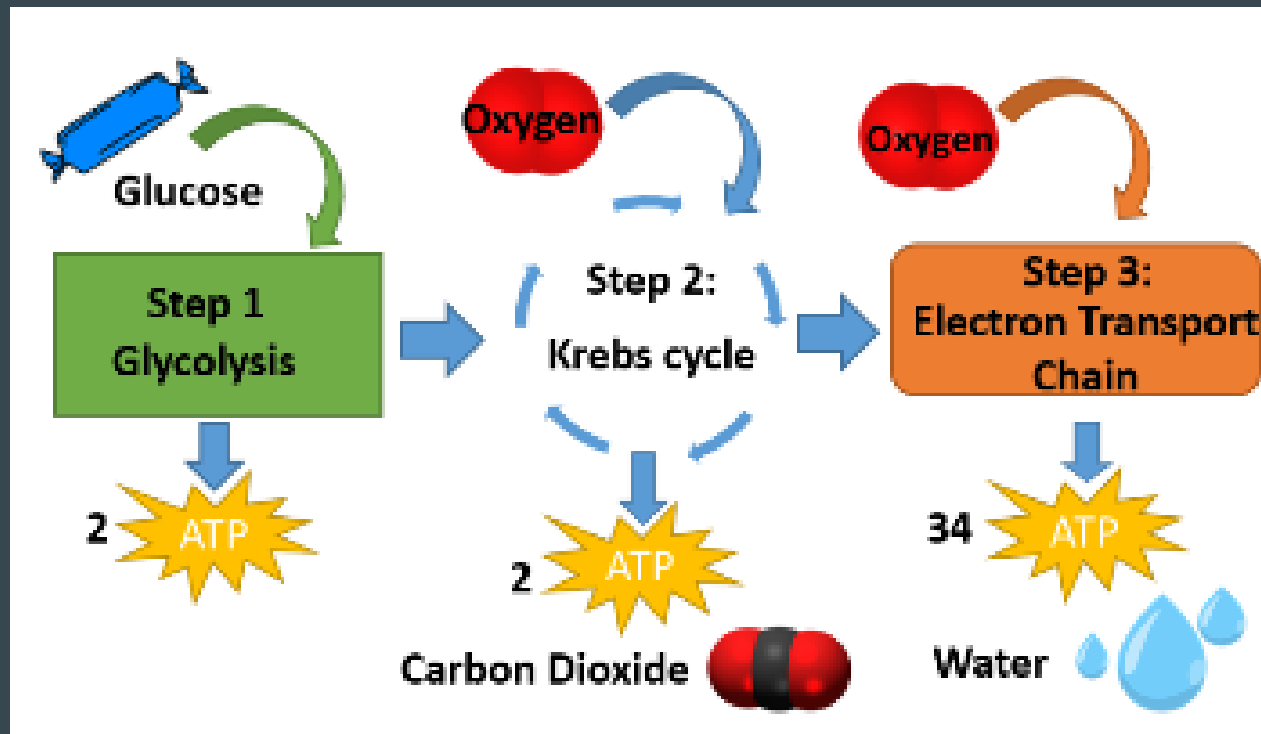
Respiration: Where does it happen?

- ▶ Mitochondria of a cell
 - Found in all eukaryotic cells
(Animals, Plants, Fungi, Protists)



Respiration: How does it happen?

Respiration has 3 main steps



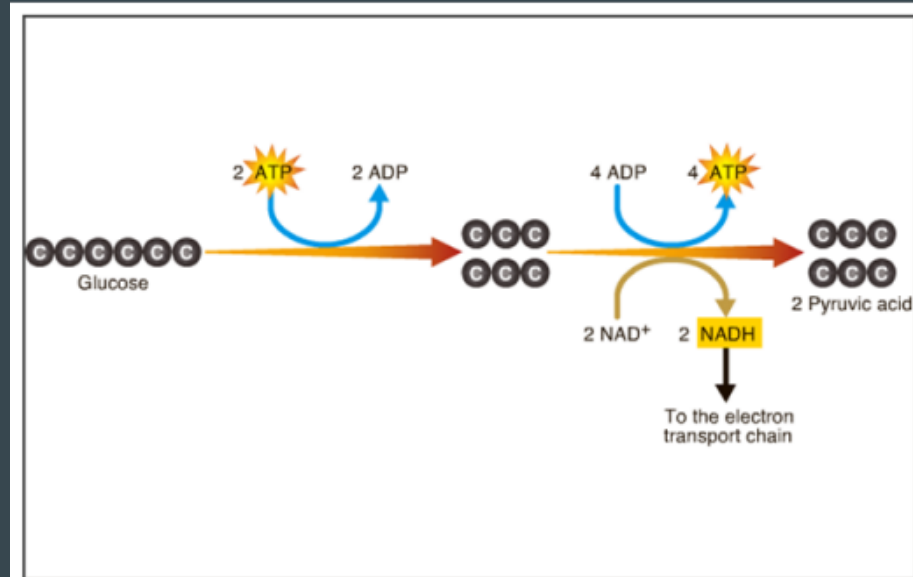
Respiration: How does it happen?

1st Step: Glycolysis

- Glucose is split into 2 parts:
- $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2 (\text{C}_3\text{H}_6\text{O}_3)$
- 2 ATPs needed to break the glucose.
- 4 ATPs produced.
- Takes place in the cytoplasm.
- No Oxygen required.

Produces 2 molecules of Pyruvic Acid

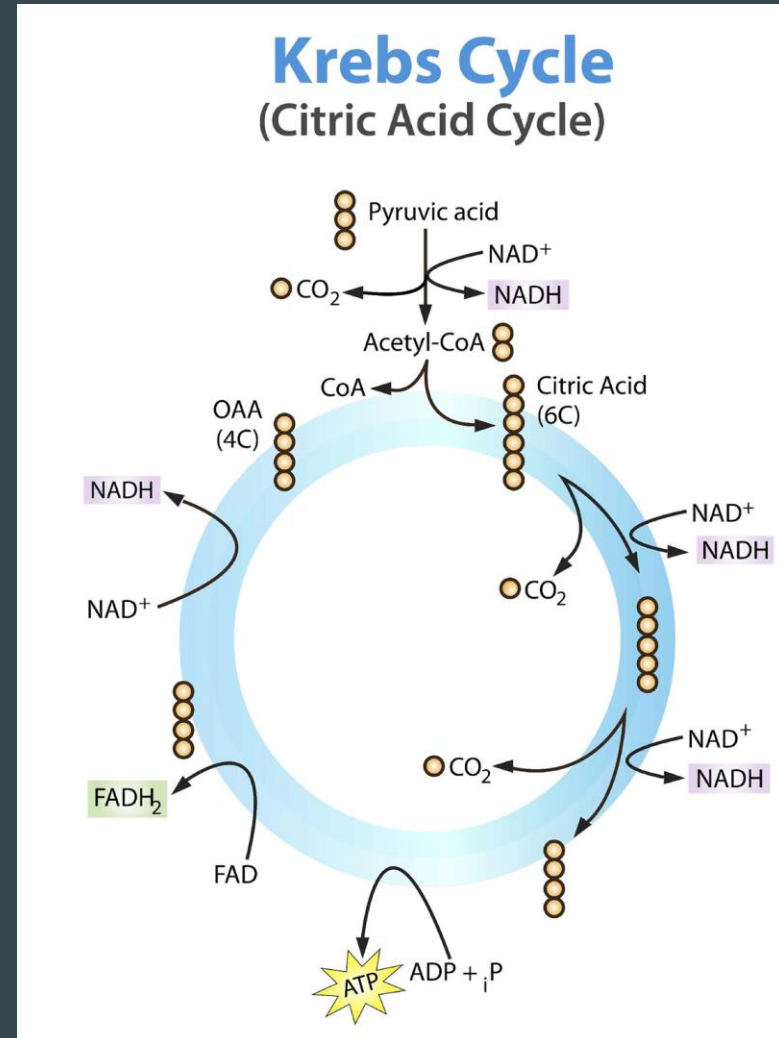
2 NADH's are also produced. These energy carrying molecules will be used in the 3rd step.



Respiration: How does it happen?

2nd Step: Krebs Cycle

- ▶ Happens in the mitochondria.
- ▶ Pyruvic Acid is stripped of electrons to be broken down into CO_2
- ▶ More ATP is produced.
- ▶ For 1 molecule of pyruvic acid:
 - ▶ 3 molecules of CO_2 are given off as waste.
 - ▶ 1 molecule of ATP is produced.

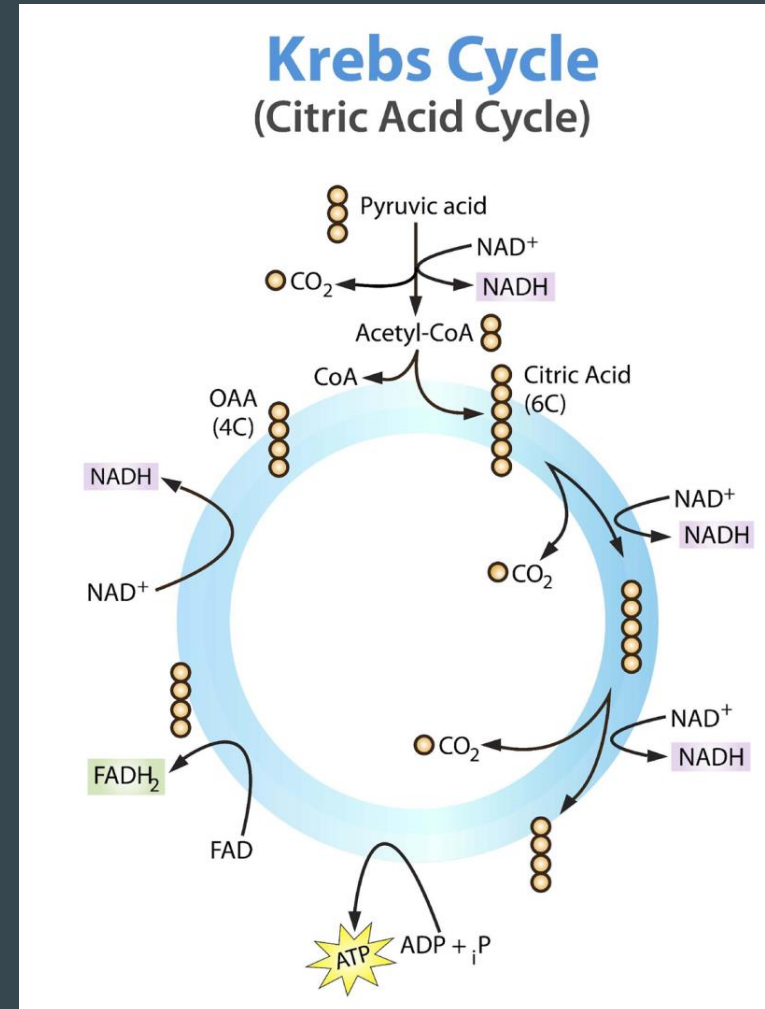


Respiration: How does it happen?

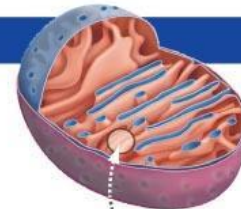
2nd Step: Krebs Cycle

- Remember we started with 2 Pyruvic Acid molecules, so for 1 glucose those values above are doubled.

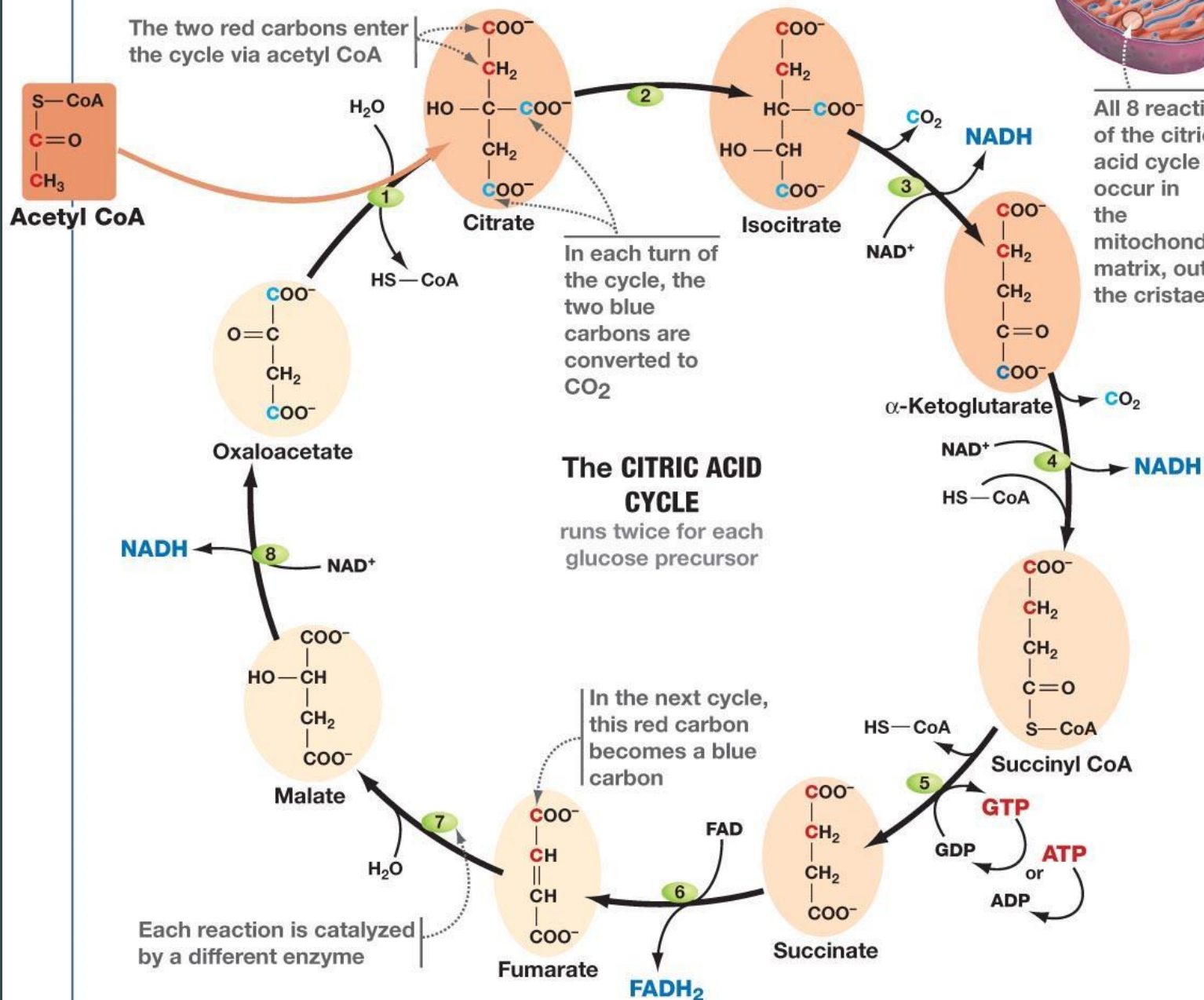
Molecules that are used to carry energy are also created (the FADH_2 and NADH above). These will be used in step 3.



PROCESS: CITRIC ACID CYCLE



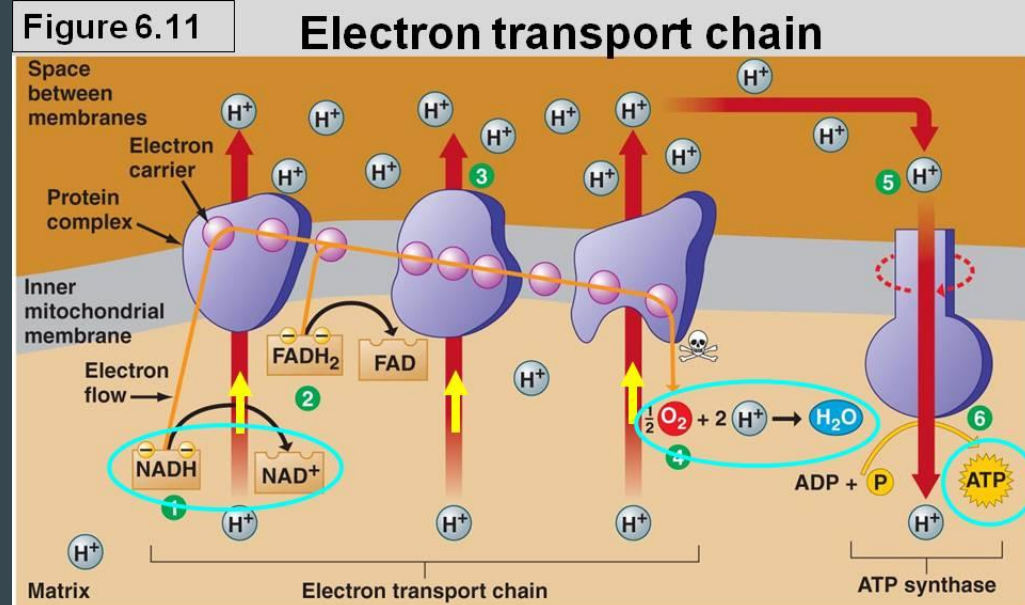
All 8 reactions of the citric acid cycle occur in the mitochondrial matrix, outside the cristae



Respiration: How does it happen?

3rd Step: Electron Transport Chain (ETC):

Energy carrying molecules (NADH & FADH) created during steps 1 & 2 transfer electrons along proteins in the inner membrane of the mitochondria, using the energy released to drive H^+ ions against their concentration gradient.

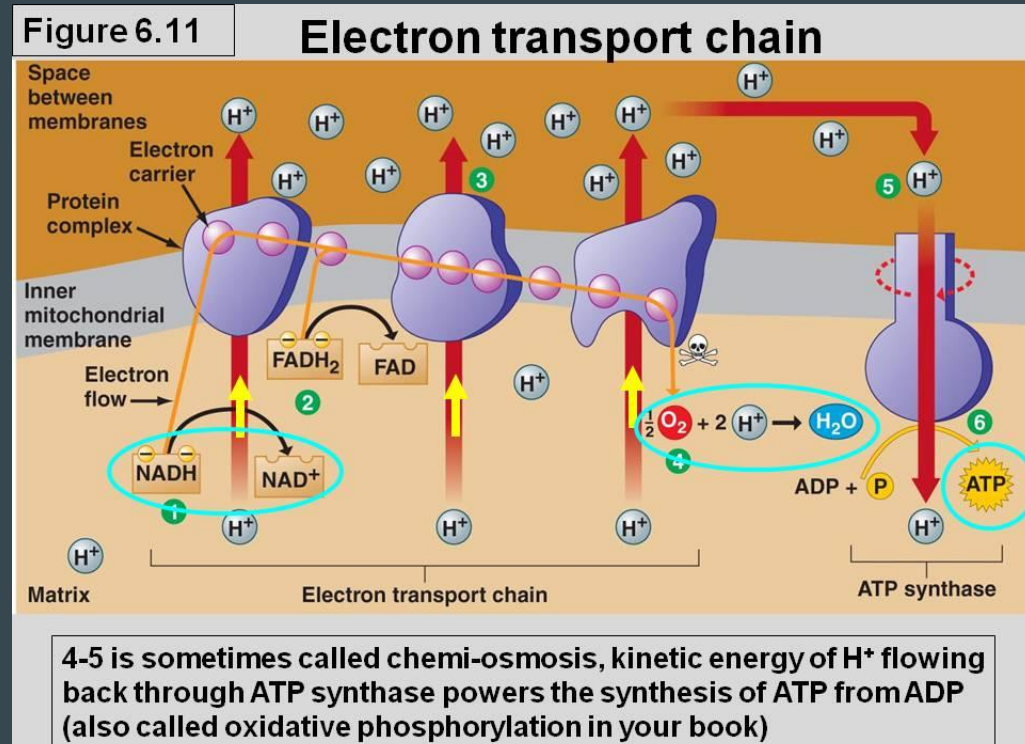


4-5 is sometimes called chemi-osmosis, kinetic energy of H^+ flowing back through ATP synthase powers the synthesis of ATP from ADP (also called oxidative phosphorylation in your book)

Respiration: How does it happen?

3rd Step: Electron Transport Chain (ETC):

At the end of the chain, a protein called ATP synthase opens to allow H^+ ions to diffuse passively back down their gradient. The energy generated from the movement of these H^+ ions is used to generate a lot of ATP.



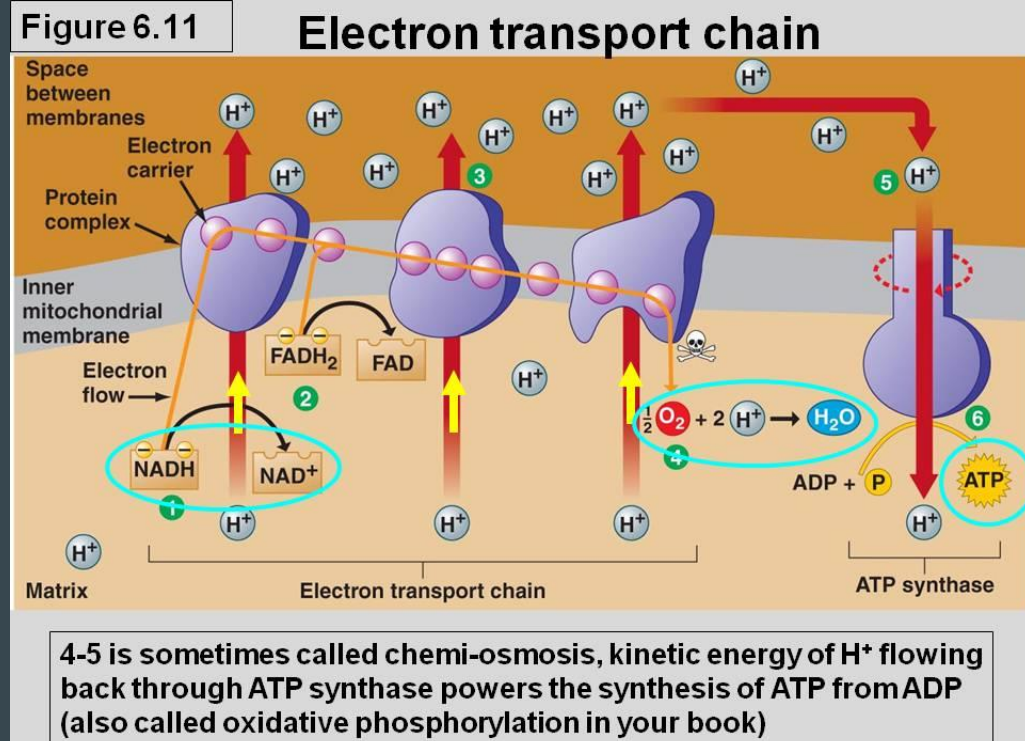
ATP Synthase

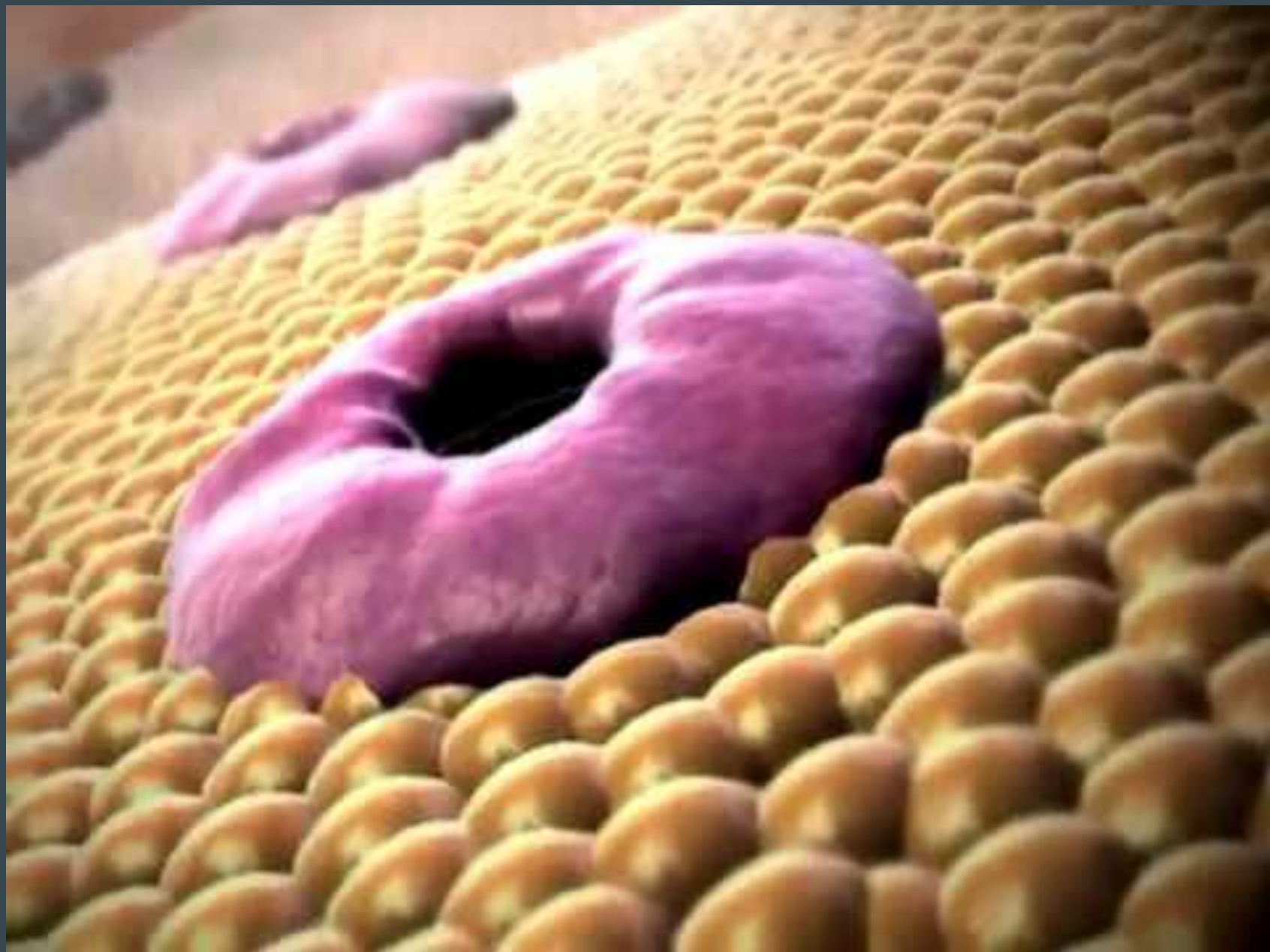


Respiration: How does it happen?

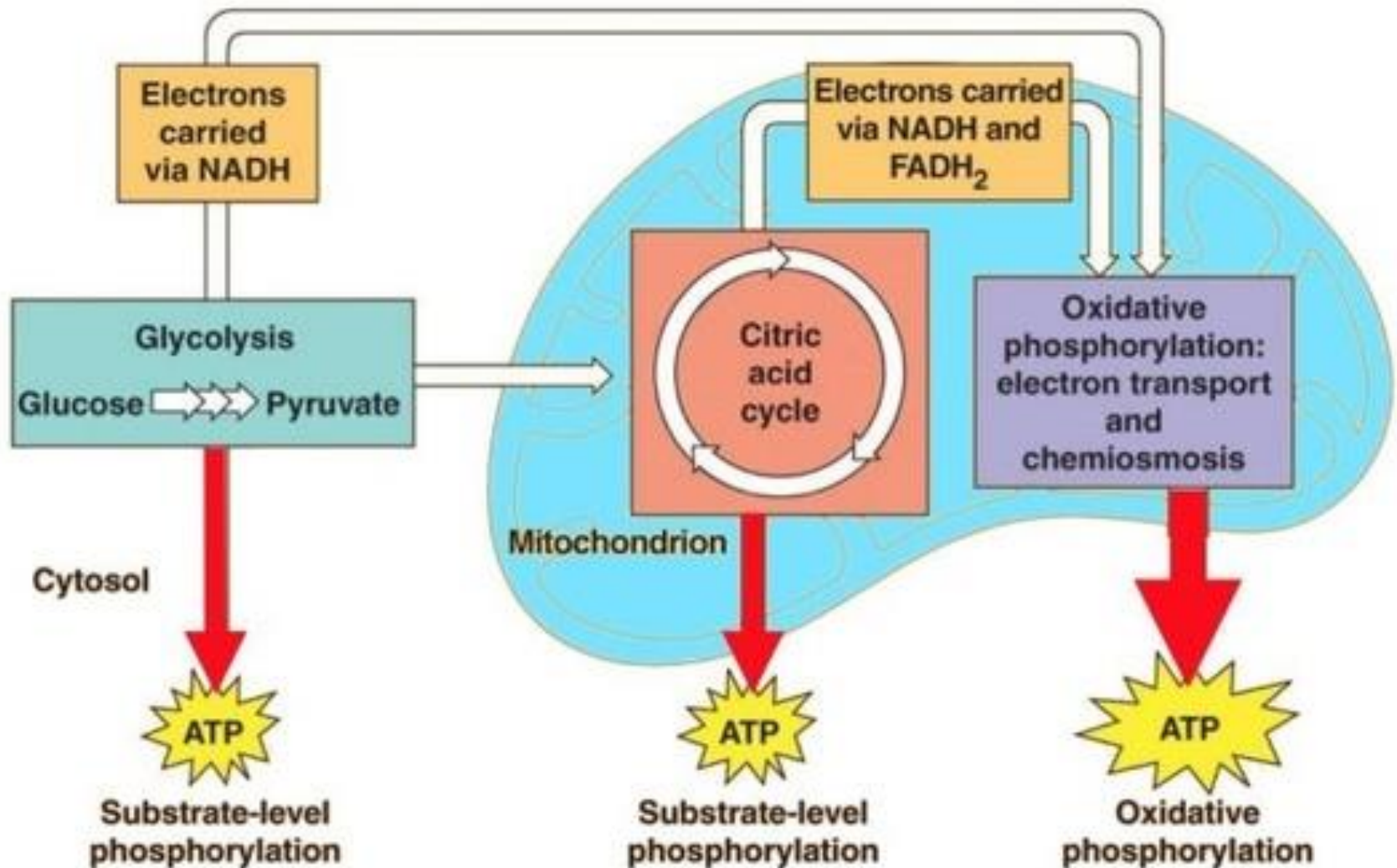
3rd Step: Electron Transport Chain (ETC):

- Hydrogen is also released and forms with oxygen to create water as a waste product.
- Up to 34 ATP are produced

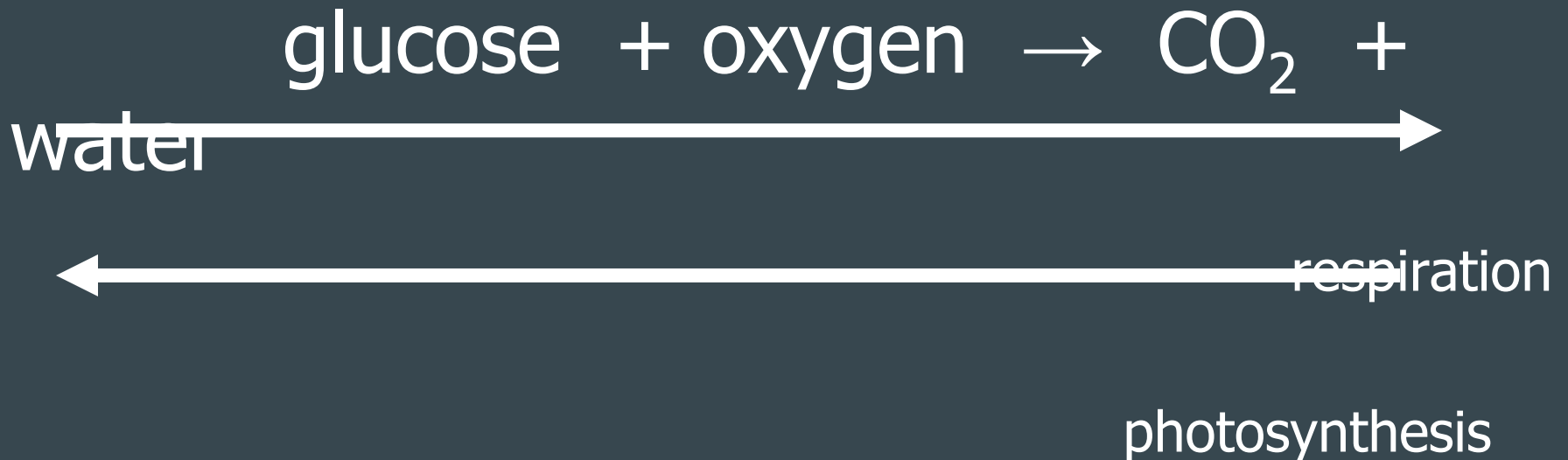




Respiration Summarized



Therefore the overall reaction of cellular respiration is the reverse of photosynthesis:



So what's the moral of the
photosynthesis – respiration story??

IT'S ALL ONE BIG CYCLE!!

NO TREES MEANS NO BREATHING!



Anaerobic respiration



- ▶ Often referred to as fermentation
- ▶ Does not require oxygen (O_2)
 - Byproduct is lactate (lactic acid) and ethanol (alcohol)
 - Only happens in oxygen deprived environments

Does not produce as much ATP as aerobic respiration, therefore plants and animals use aerobic respiration whenever they can.

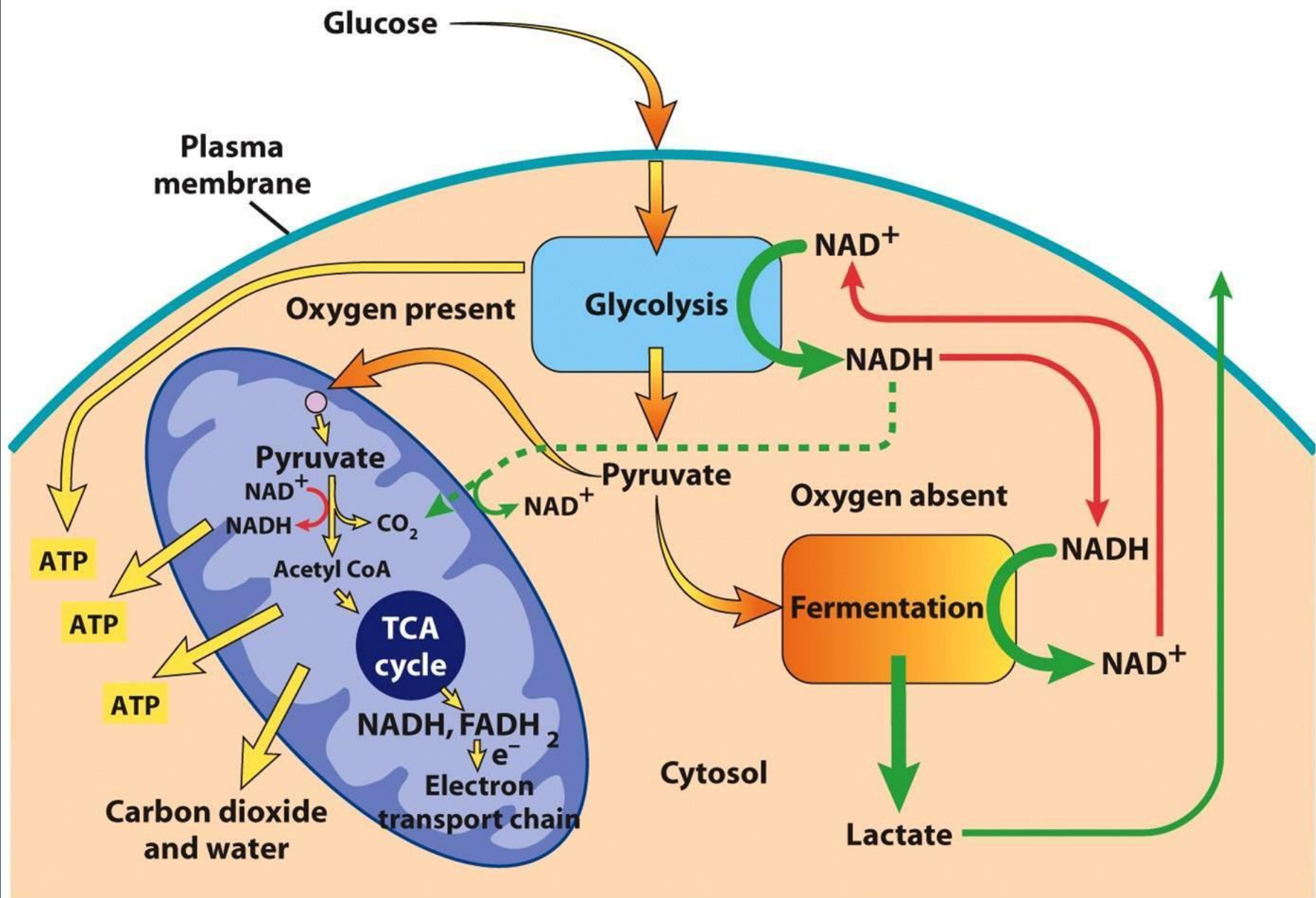


Figure 5-5 Cell and Molecular Biology, 5/e (© 2008 John Wiley & Sons)

Want more review?

