

# ATP – Structure & Function

pp 17, 31, 86, 113, 270-272, 349

# Anaerobic and Aerobic Respiration

pp 277-278, 272-275

# Mitochondria Structure and Function

Mrs Cooper ATP – On Your Own

<https://www.youtube.com/watch?v=LL3Ogl1wYrU>

Mito pp 16-17, 276

Res pp 272-275, 277-278

## G11 Biology 2017-2018

### Learning Objective

1. Know the structure and function of ATP.
2. Compare the formation of ATP in aerobic and anaerobic respiration.
3. To establish the relationship of mitochondrial structure and processes of cellular respiration.

### Success Criteria – To Be Determined

# Terminology

Prof Dave ATP – 4 min **In class**

<https://www.youtube.com/watch?v=-6VyMFQ7rRo>

English	Google Russian 😊
Adenosine Triphosphate (ATP) Inorganic phosphate Pi currency hydrolysis / condensation Metabolic catabolic, breakdown anabolic, build Anaerobic / aerobic respiratory pathways substrate level phosphorylation oxidative phosphorylation	Аденозинтрифосфат (АТФ) Неорганический фосфат Pi валюта гидролиз / конденсация метаболический катаболизм, пробой анаболический, строить Анаэробные / аэробные дыхательные пути фосфорилирование уровня субстрата окислительного фосфорилирования

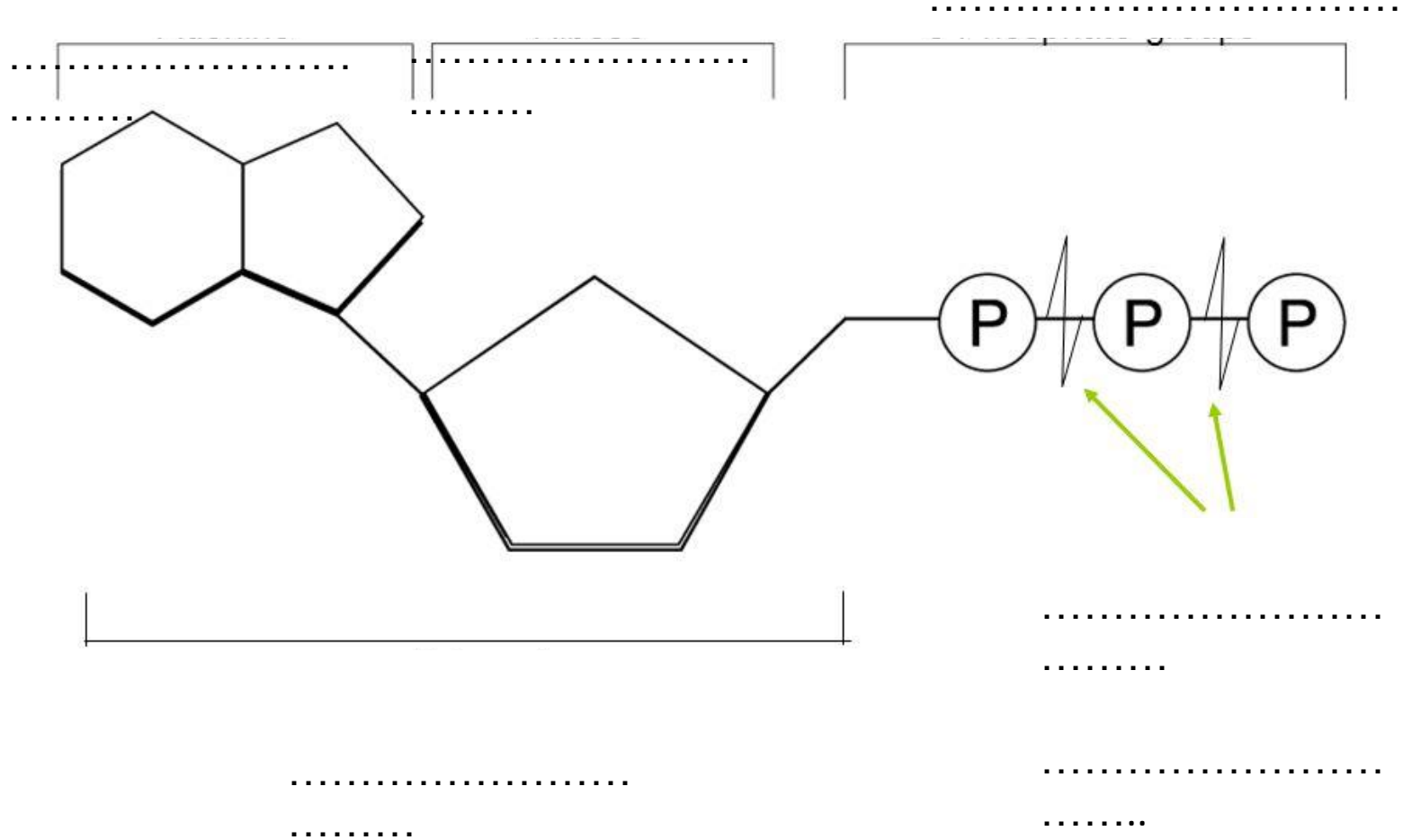
Adenine

High Energy Bonds

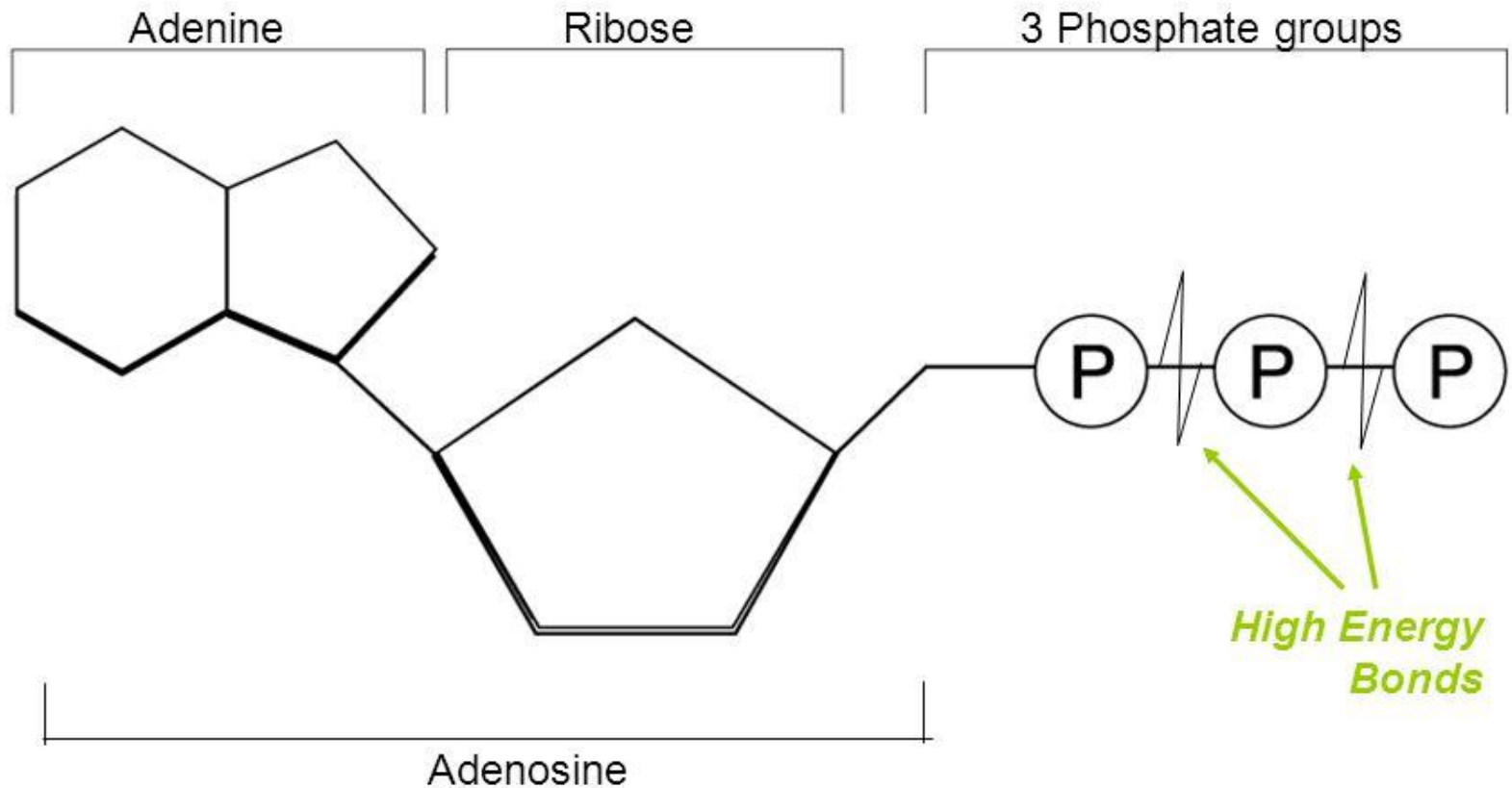
Phosphate

Ribose

Nucleoside



# Adenosine Triphosphate - ATP



## Structure of adenosine triphosphate (ATP)

The ATP molecule (Figure 1) is a phosphorylated nucleotide and it has three parts:

- **Adenine** – a nitrogen-containing organic base belonging to the group called purines.
- **Ribose** – a sugar molecule with a 5-carbon ring structure (pentose sugar) that acts as the backbone to which the other parts are attached.
- **Phosphates** – a chain of three phosphate groups.

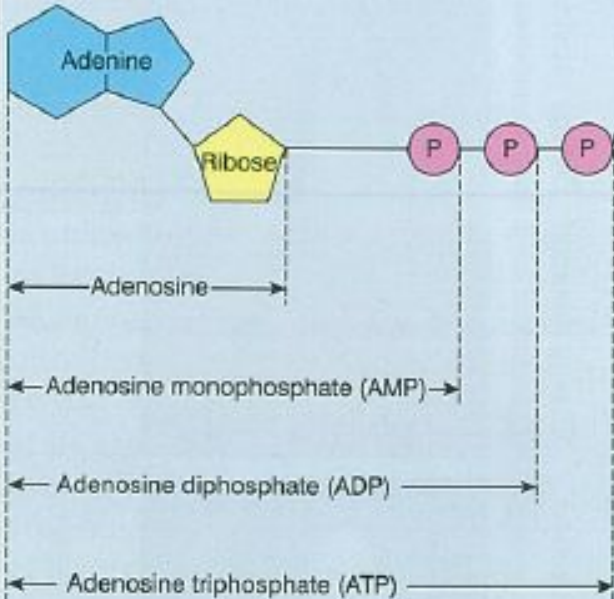


Figure 1 Structure of ATP

# Adenosine Triphosphate

**Universal Energy Currency** – all living things use ATP as an energy source

## Reasons for ATP's Universal Success

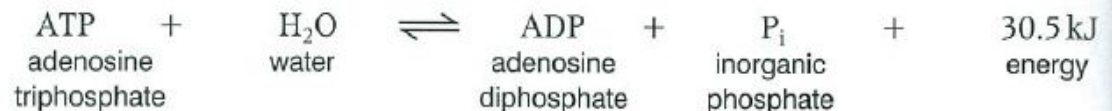
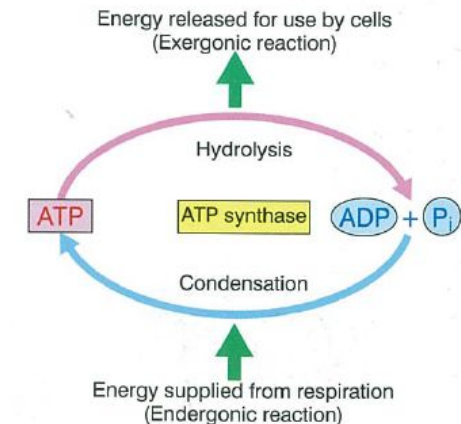
1. ATP is water soluble
2. ATP diffuses through a cell easily.
3. It is easily hydrolyzed to release energy
4. It recycles/cycles ATP  $\rightleftharpoons$  ADP + P<sub>i</sub>

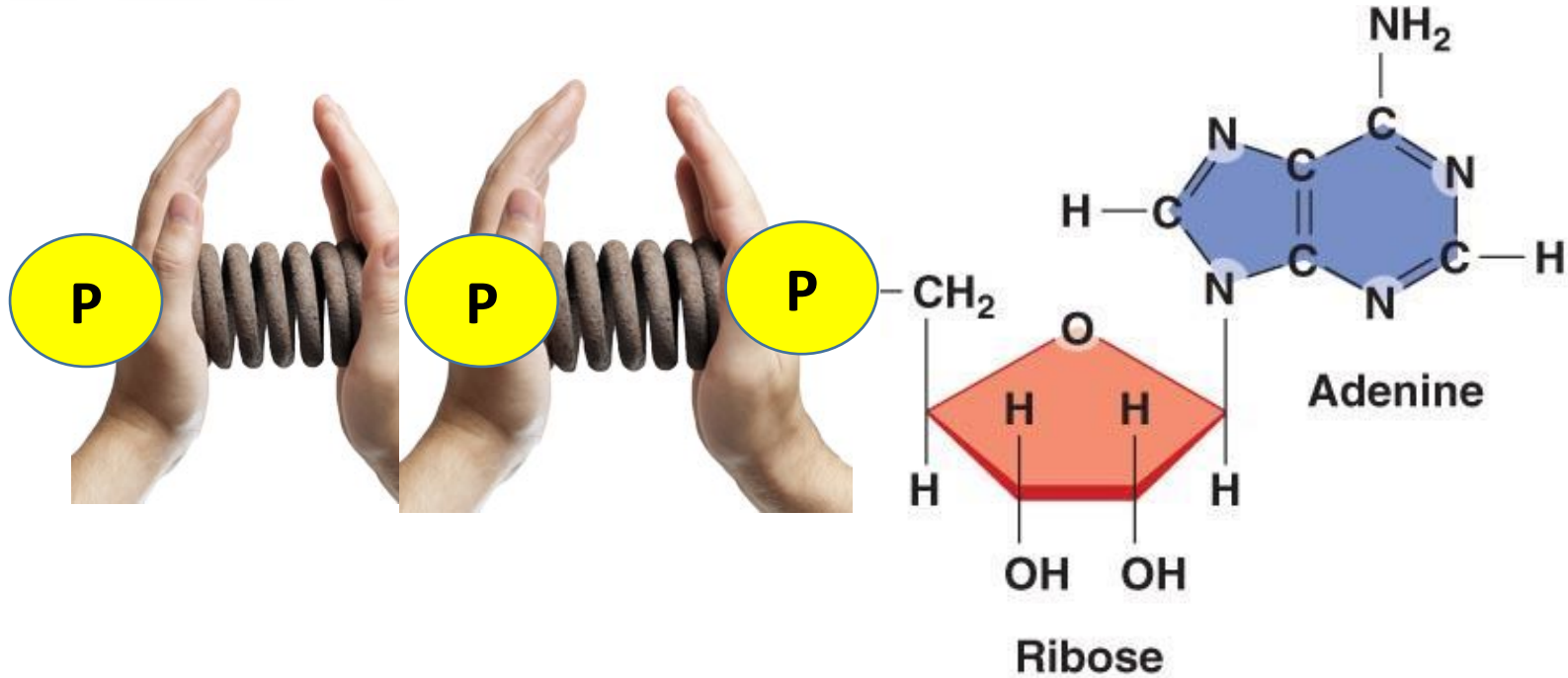
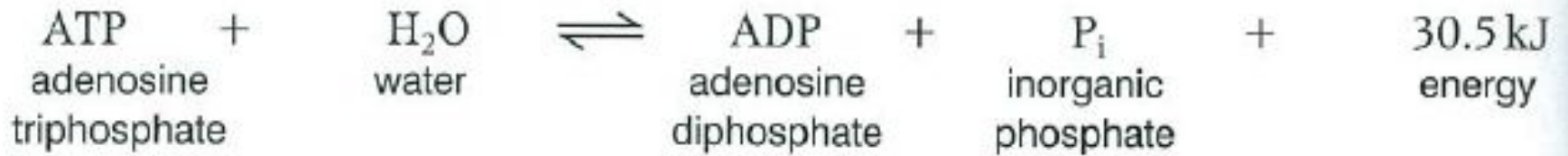
Phosphate bonds are easily broken

-Easily release their energy

-ATP is Recycled 😊  $\square$

-ATP releases a lot of energy 30.5 kJ



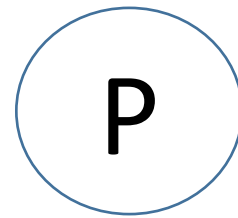


Energy stored bond between phosphates like a coiled spring.

# Diagram and Label on your desk

## ATP, ADP, AMP

Inorganic Phosphate



or Pi

Adenine

Ribose

**Check your neighbors work!**

# How do living things use ATP?

List as many as you can on your desk 😊

Compare with your neighbors 😊 😊



# Just a few ways living things use ATP.

DNA replication – growth and development

Protein synthesis – growth, development, and important biological molecules (enzymes, hormones, muscle tissue)

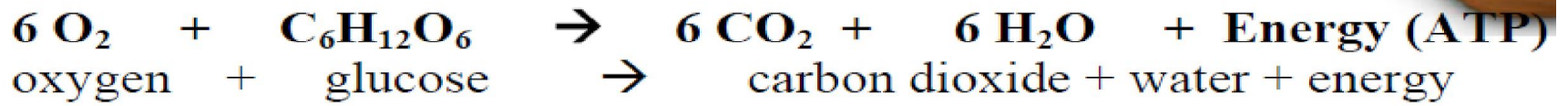
Movement – muscles must to have ATP power contraction

Body heat – the metabolic reactions release the energy stored in ATP to your body.

Active Transport – ATP provides energy to move molecules against the gradient.

**An amoeba eating food phagocytosis**

<https://www.youtube.com/watch?v=W6rnhiMxtKU>



respiration in **ALL** Cells

respiration in **Eukaryotic Cells**

Electrons carried

By \_\_\_\_\_

1

GLYCOLYSIS

2  
Link Reaction  
Acetyl CoA

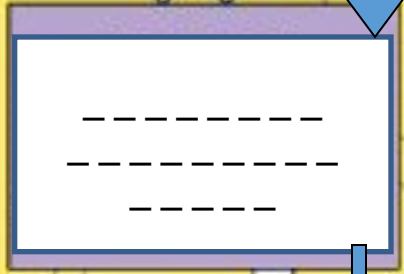
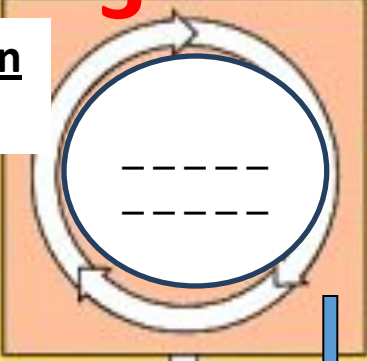
3

4

\_\_\_\_\_ + \_\_\_\_\_  
2 (electron carriers)

\_\_\_\_\_

\_\_\_\_\_

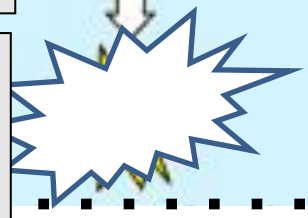


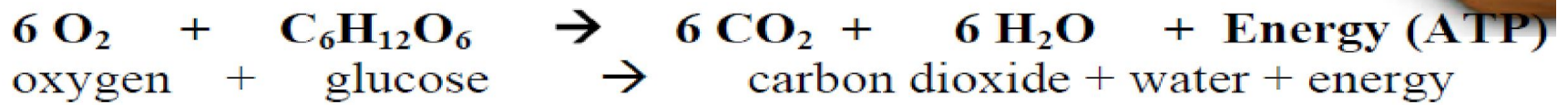
\_\_\_\_\_

\_\_\_\_\_

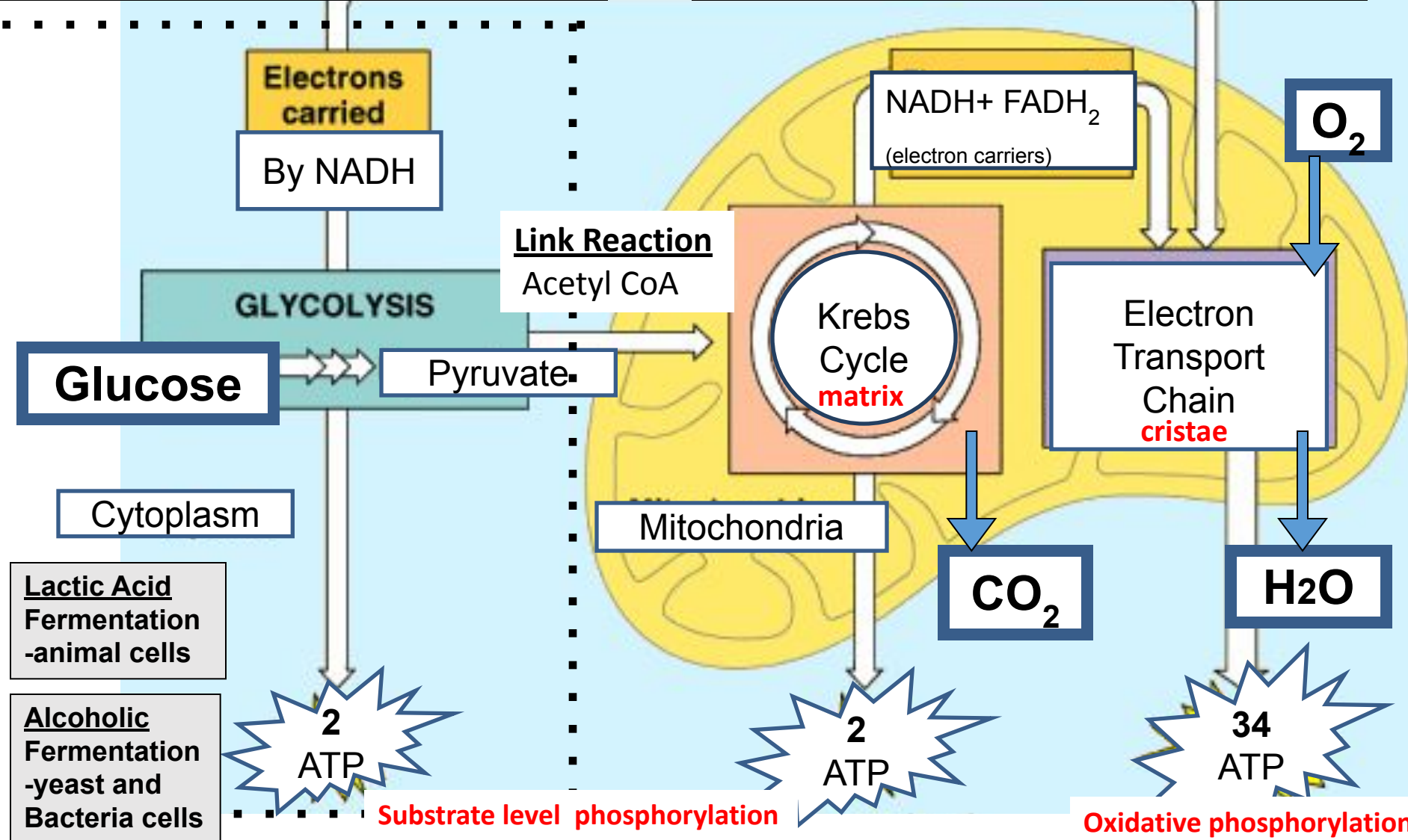
\_\_\_\_\_ Fermentation  
-animal cells

\_\_\_\_\_ Fermentation  
-yeast and  
Bacteria cells

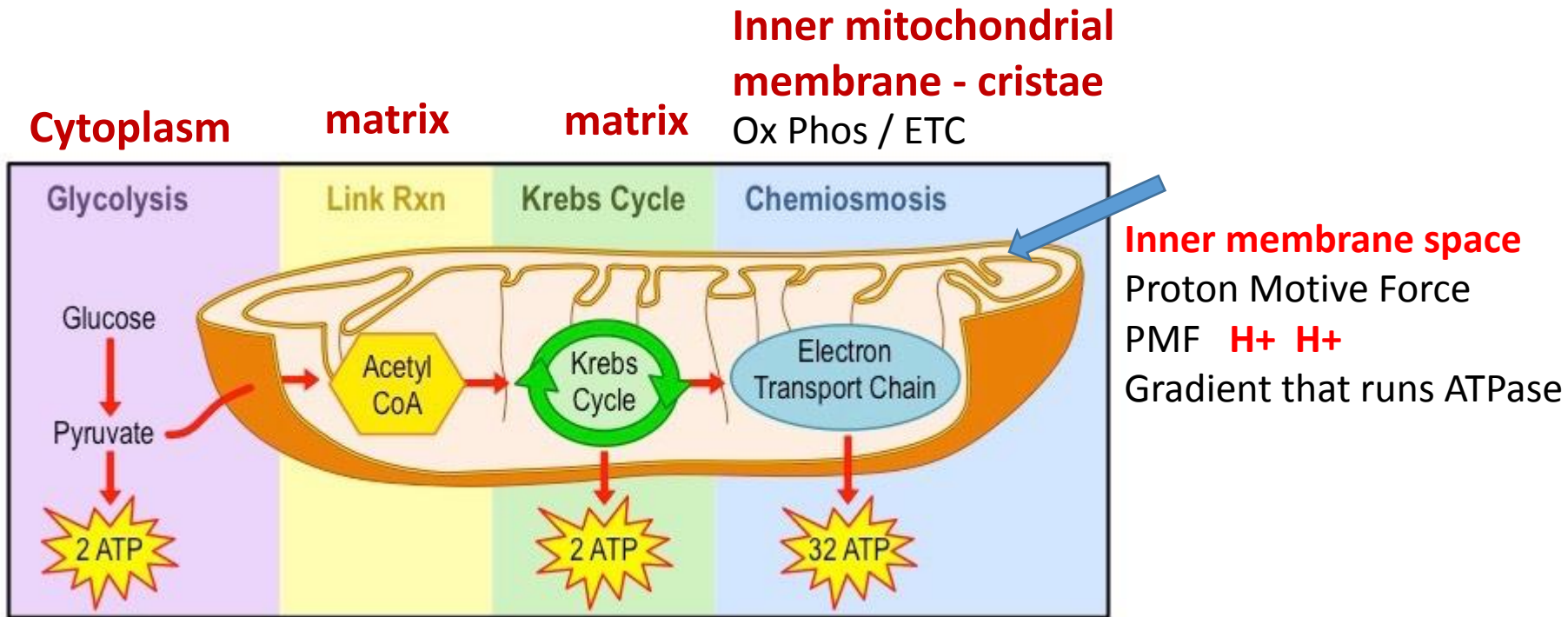




ANAEROBIC respiration in ALL Cells      AEROBIC respiration in Eukaryotic Cells



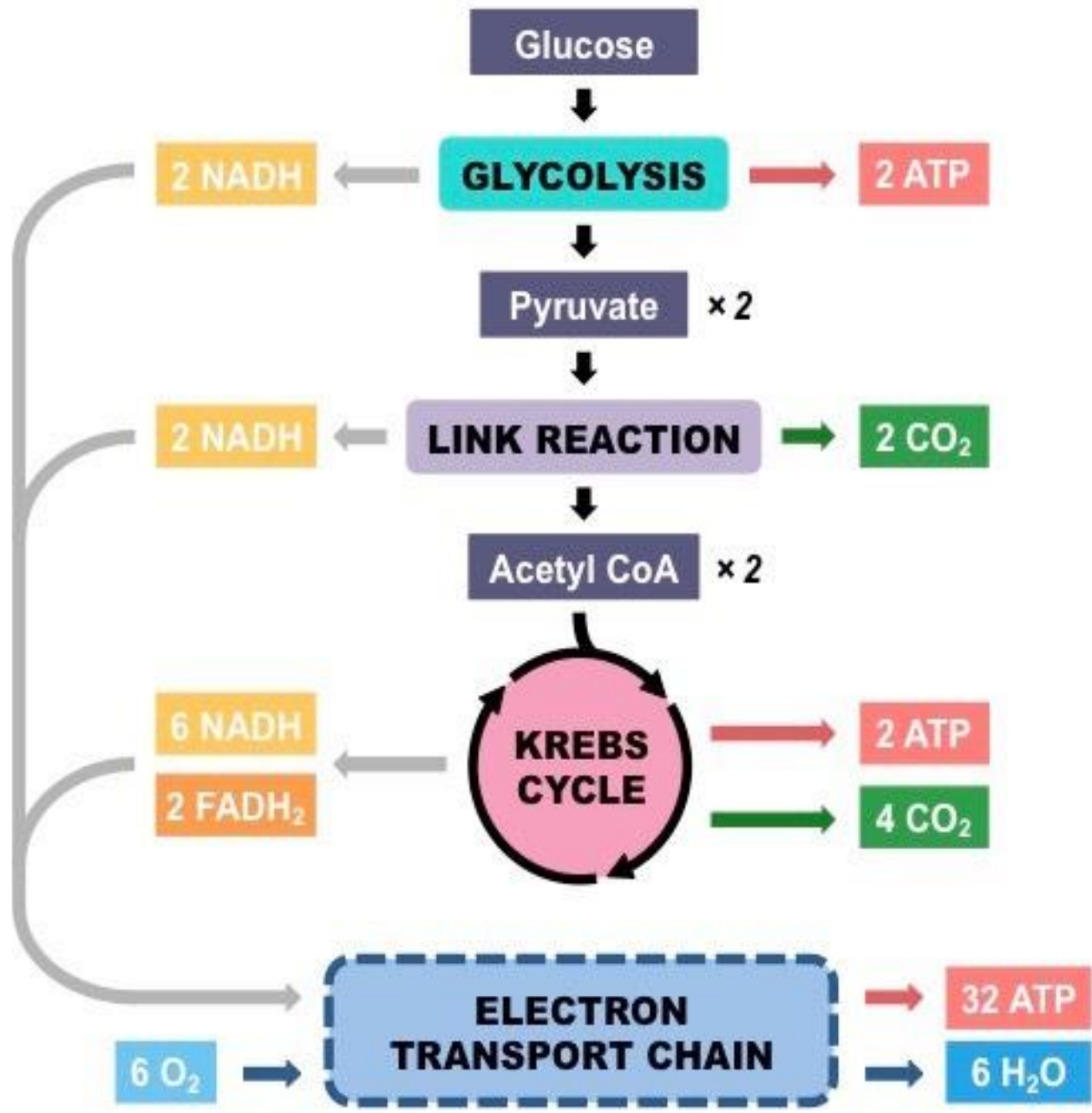
# Cellular Respiration



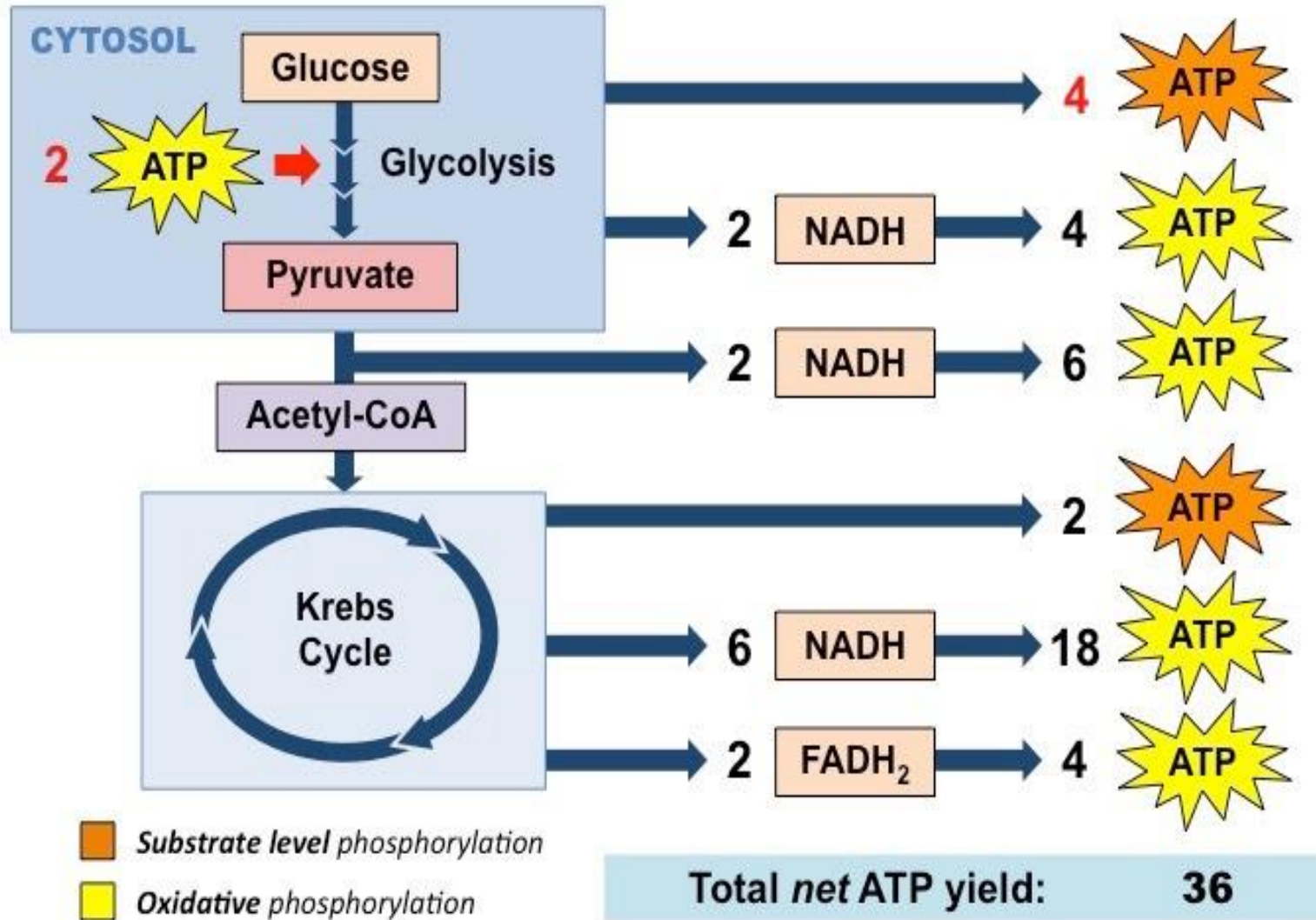
**Mitochondria size 1 – 10 $\mu$ m**

## Vocabulary

- Final electron acceptor
- Stalked particle
- Rotor
- Coiled spring
- Oxygen debt



# ATP Production



1 NADH	□	2.5 -3 ATP
1 FADH <sub>2</sub>	□	1.5- 2 ATP

# Aerobic Respiration

## ATP Molecules from 1 Glucose

Substrate Level phosphorylation

Glycolysis.....  
 ..... 2

Krebs.....  
 .....2

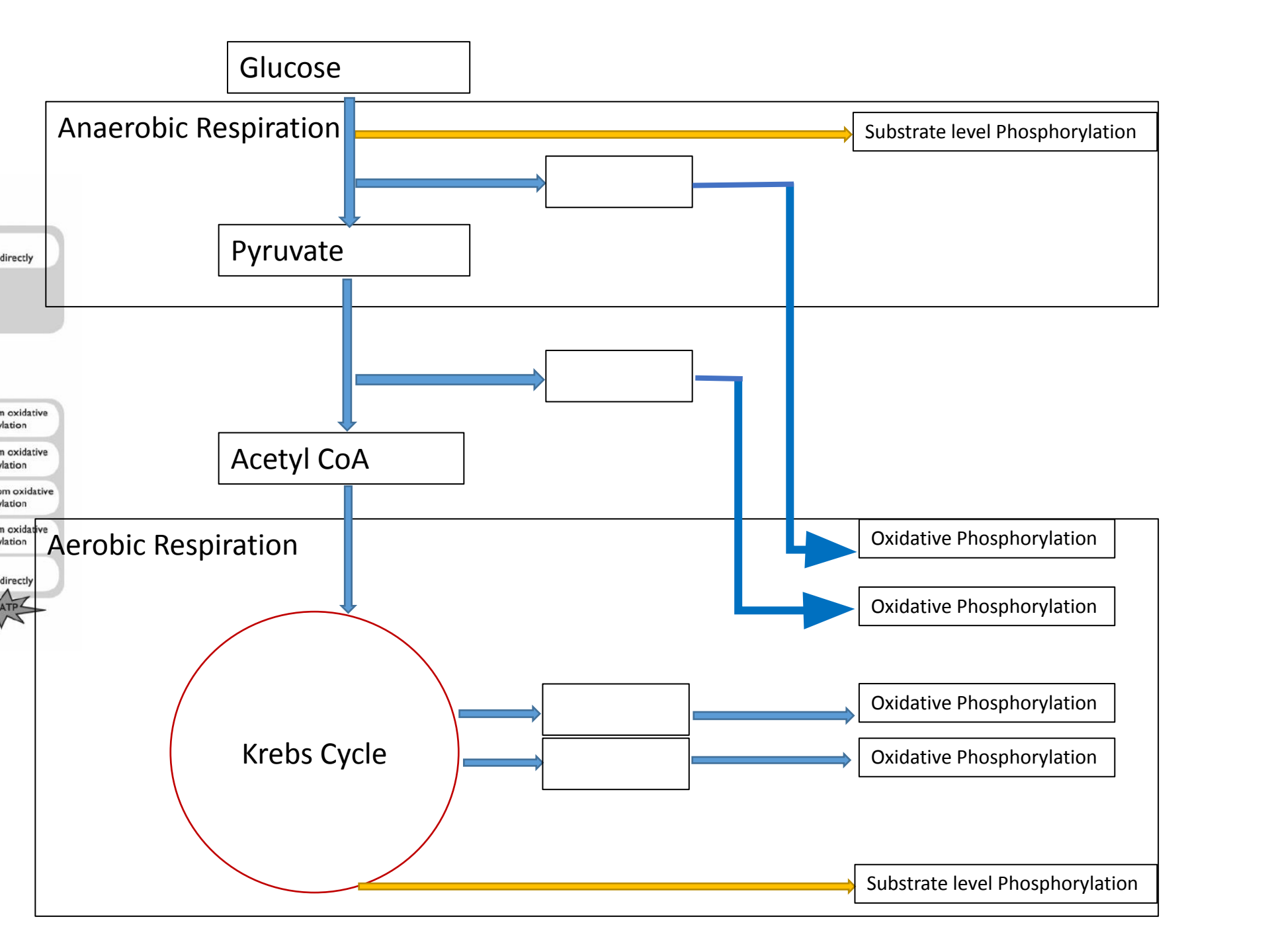
Oxidative phosphorylation

**Perspective**  
 2 reduced from NAD from glycolysis .....6

*Aerobic Respiration is only 33% efficient. A car is 25% efficient.*

8 reduced from NAD from Krebs cycle .....24

2 reduced from FAD from Krebs cycle ..... 4





## **Substrate-level phosphorylation**

- direct formation of ATP from the transfer of a phosphate from a substrate to ADP.
- occurs in glycolysis and the Krebs cycle.

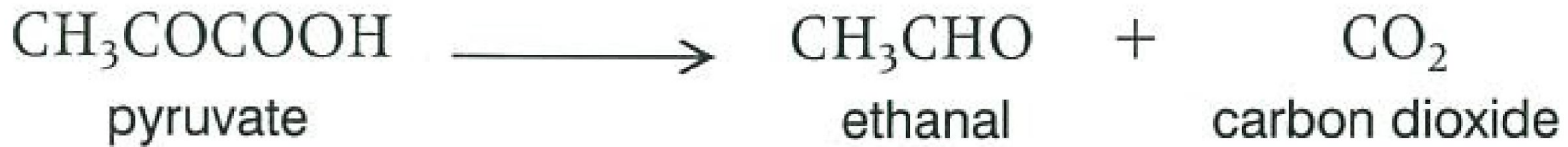
## **Oxidative Phosphorylation (ETC)**

- indirect formation of ATP from the oxidation of NADH and  $\text{FADH}_2$  and the next step of the transfer of electrons and pumping of protons and using  $\text{O}_2$  as a final acceptor
- occurs via the electron transport chain

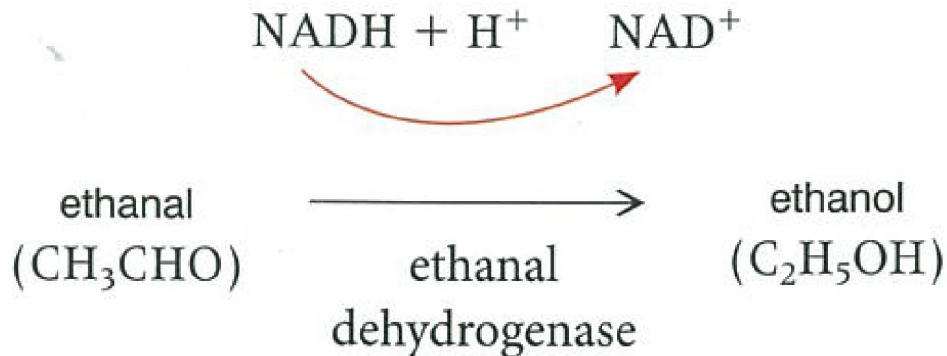
# Anaerobic Respiration

## Alcoholic Fermentation – 2 step process

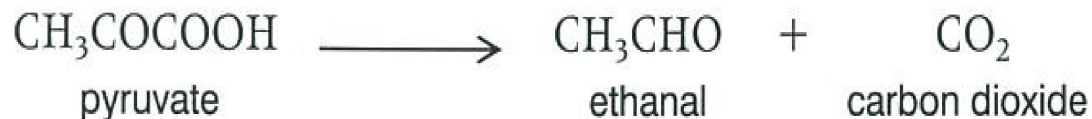
### 1. Decarboxylation of pyruvate



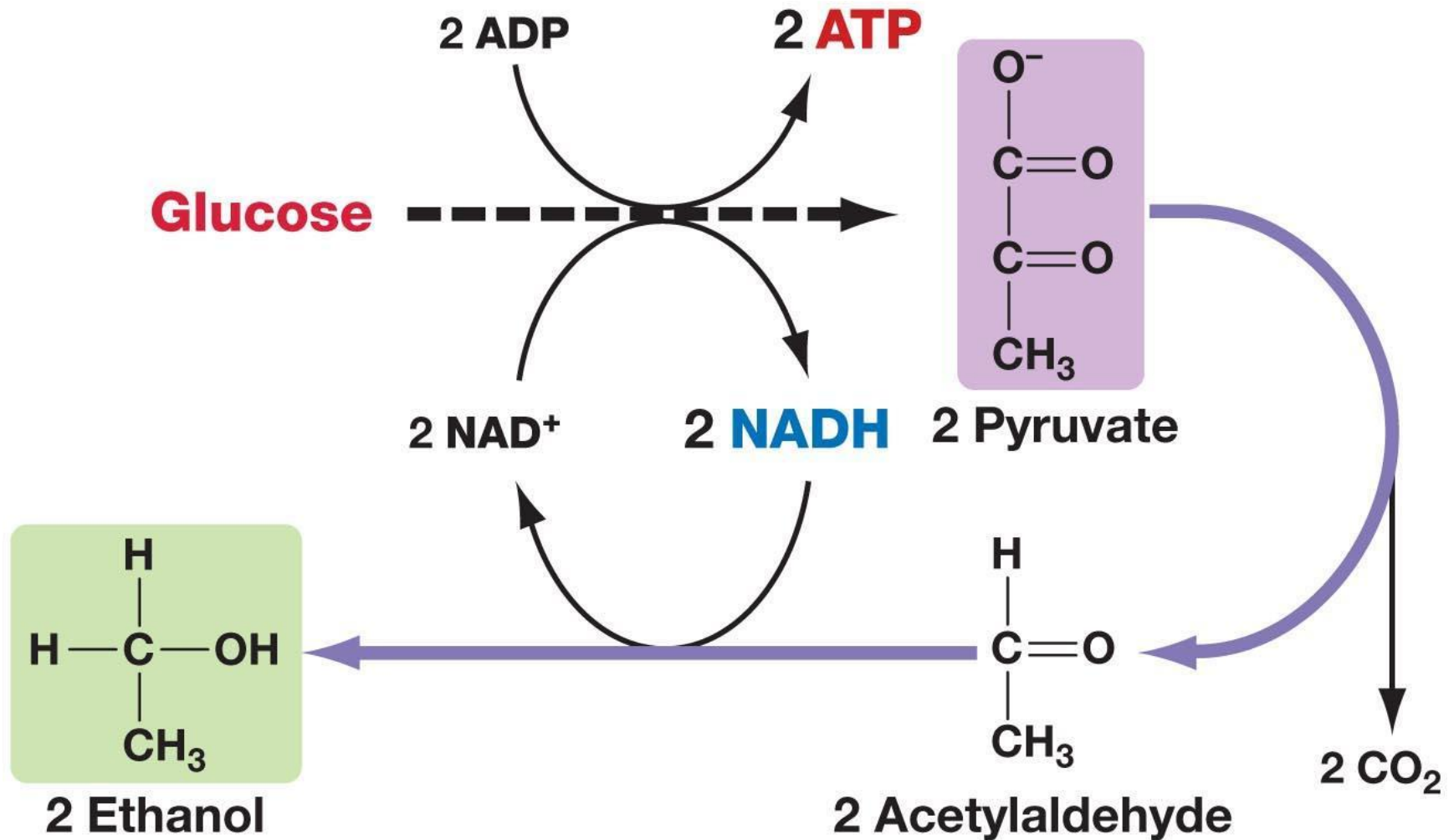
### 2. Ethanol accepts 1 hydrogen from NADH + H<sup>+</sup> to form Ethanol



### Summary Diagram



## (b) Alcohol fermentation occurs in yeast.



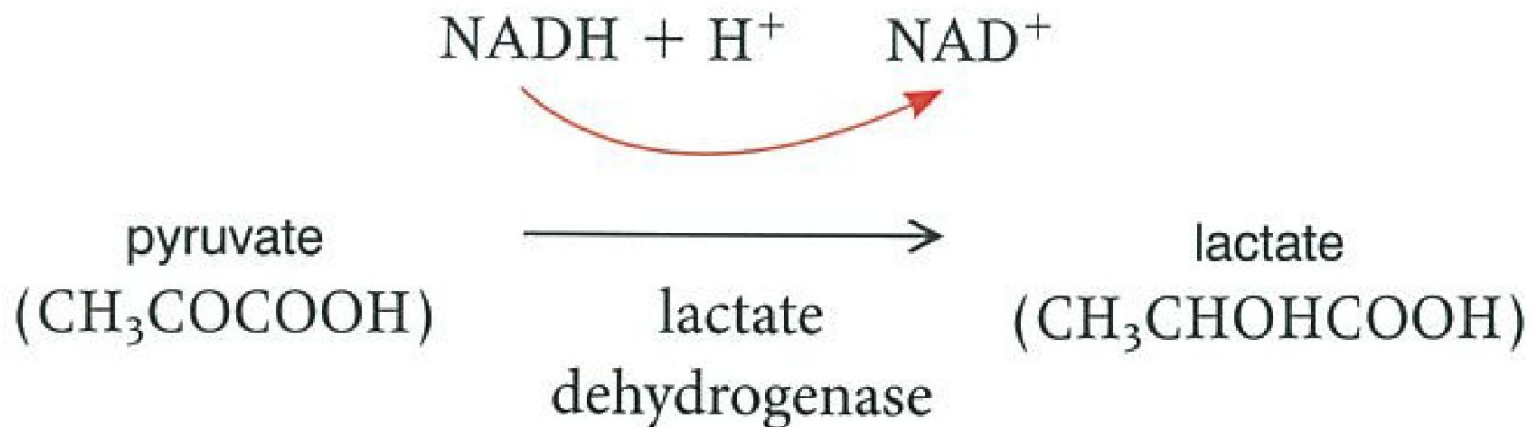
# Anaerobic Respiration

Lactic Acid Fermentation in animals to overcome lack of oxygen

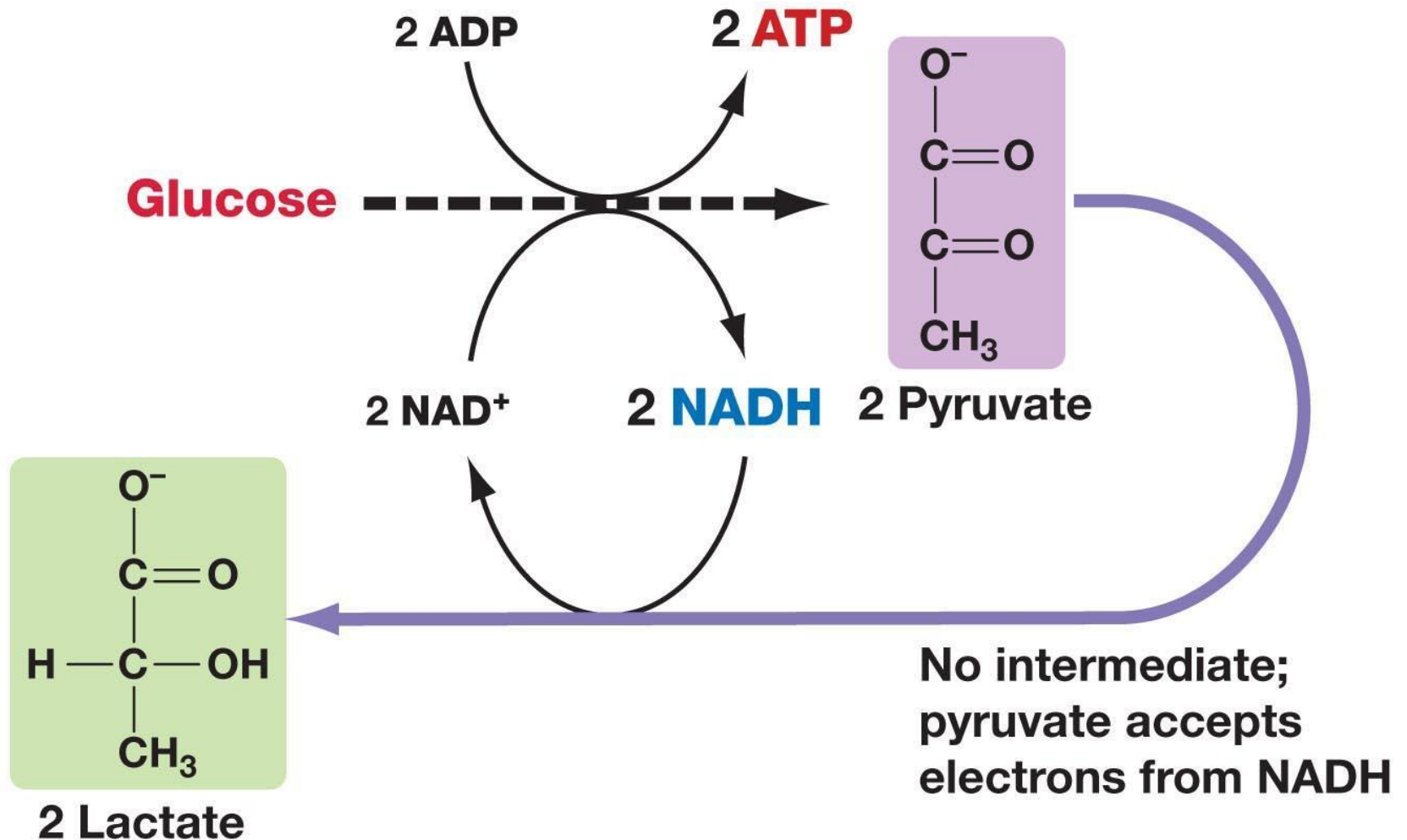
Oxygen Debt – when oxygen is used up more rapidly than it can be supplied.

Once oxygen is available again NADH is regenerated and lactate returns to pyruvate

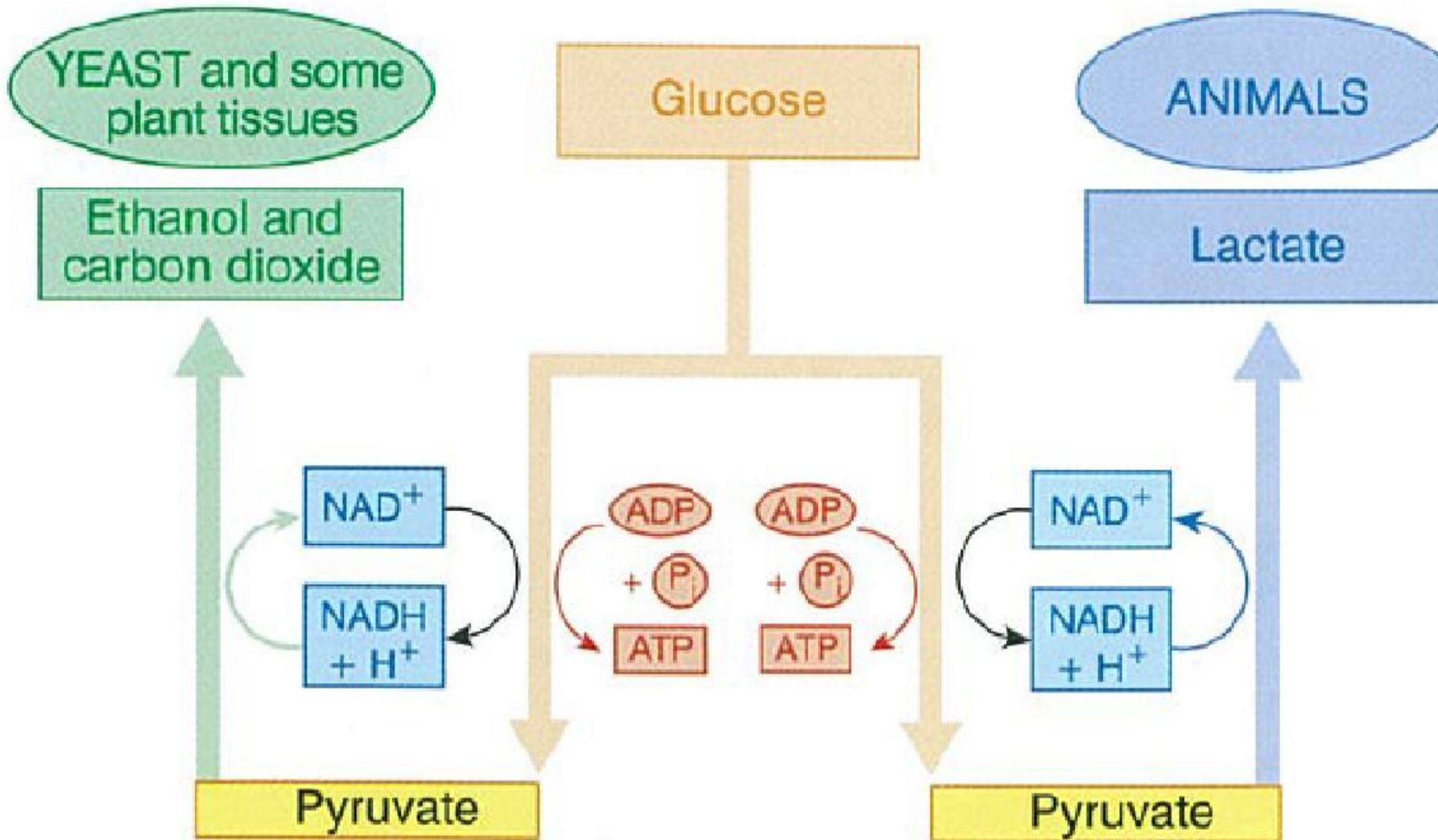
1. Each pyruvate takes up 2- hydrogens from NADH + H to form lactate (Lactic Acid)



# (a) Lactic acid fermentation occurs in humans.



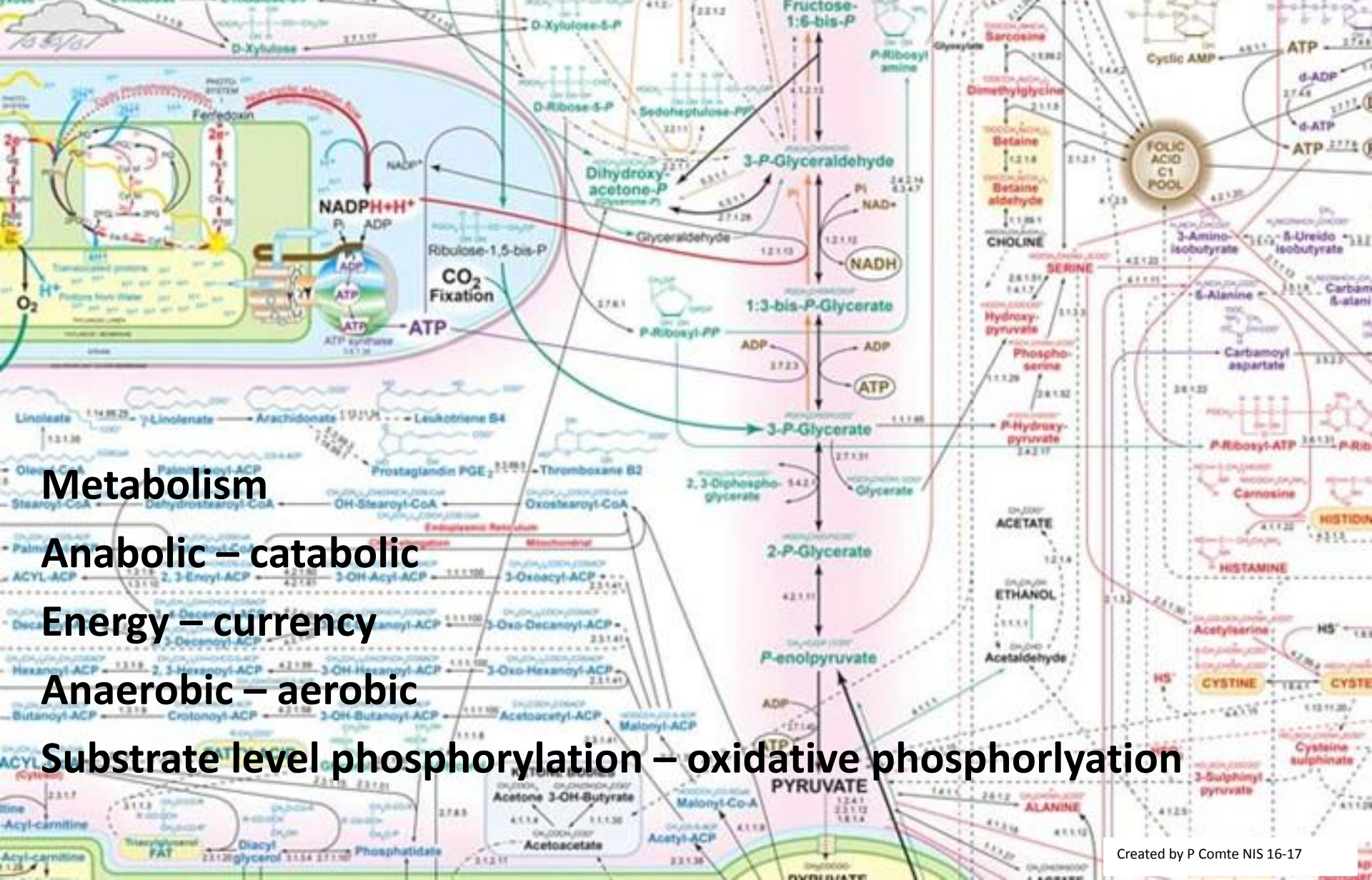
How the  $\text{NAD}^+$  needed for glycolysis is regenerated during fermentation in yeast and animal cells.



End

# Metabolic Pathways, Mitochondria, ATP

## Anaerobic – Aerobic



Metabolism

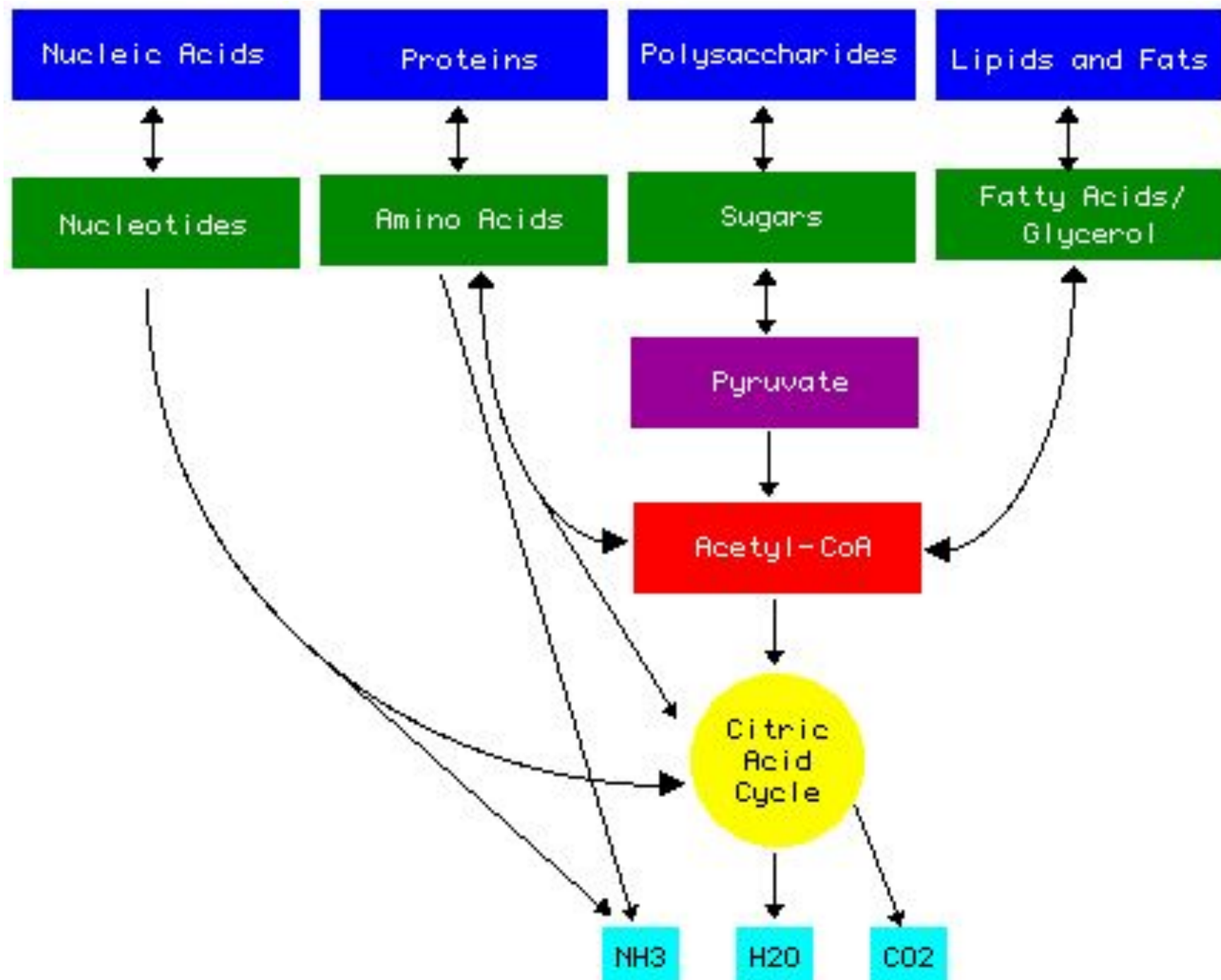
Anabolic – catabolic

Energy – currency

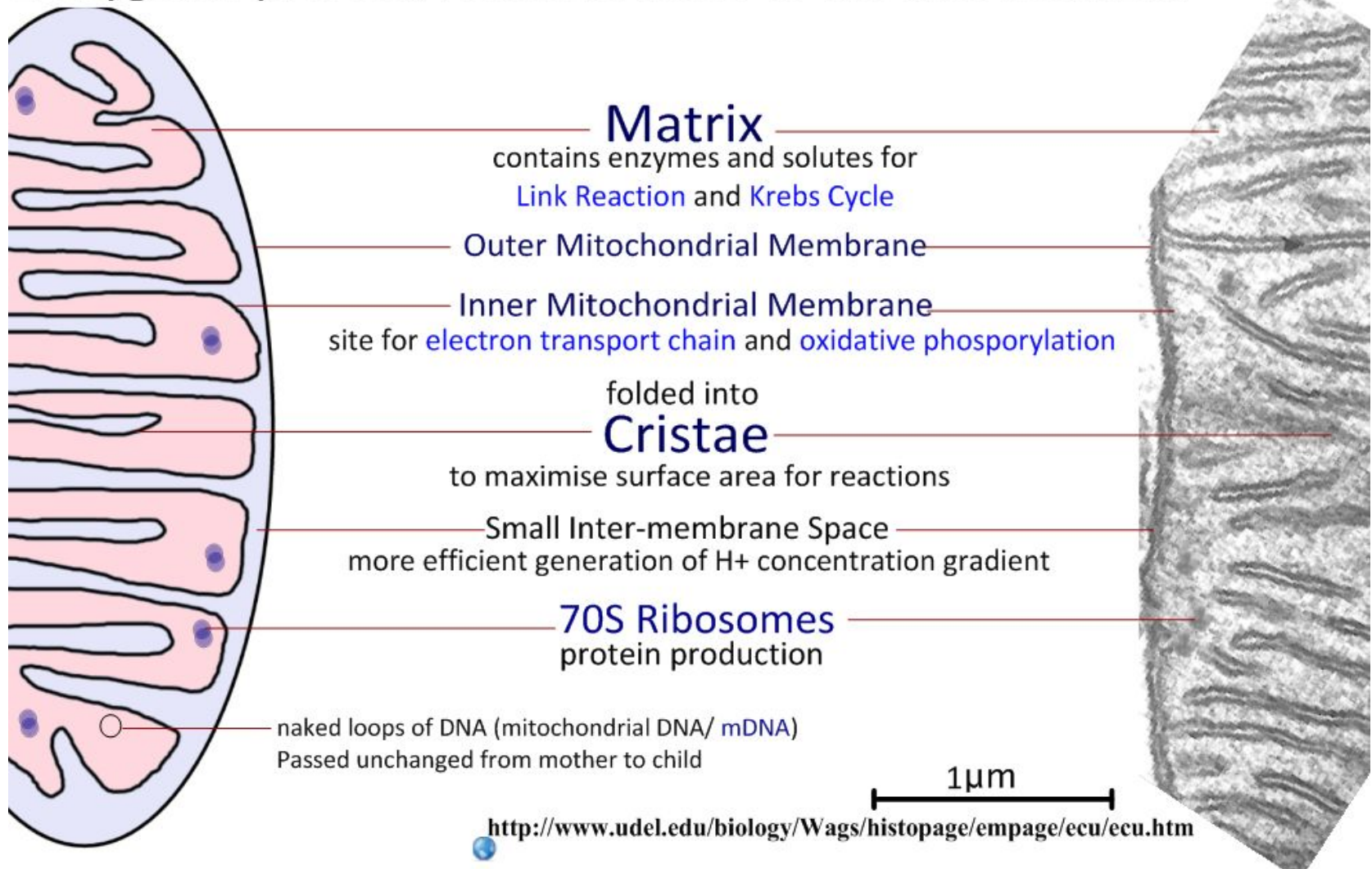
Anaerobic – aerobic

Substrate level phosphorylation – oxidative phosphorylation





If oxygen is present, reactions move to the mitochondria:



Intermembrane space

Ribosome

Granule

Outer - Inner membrane = 20nm

Matrix

ATP synthase particles

DNA

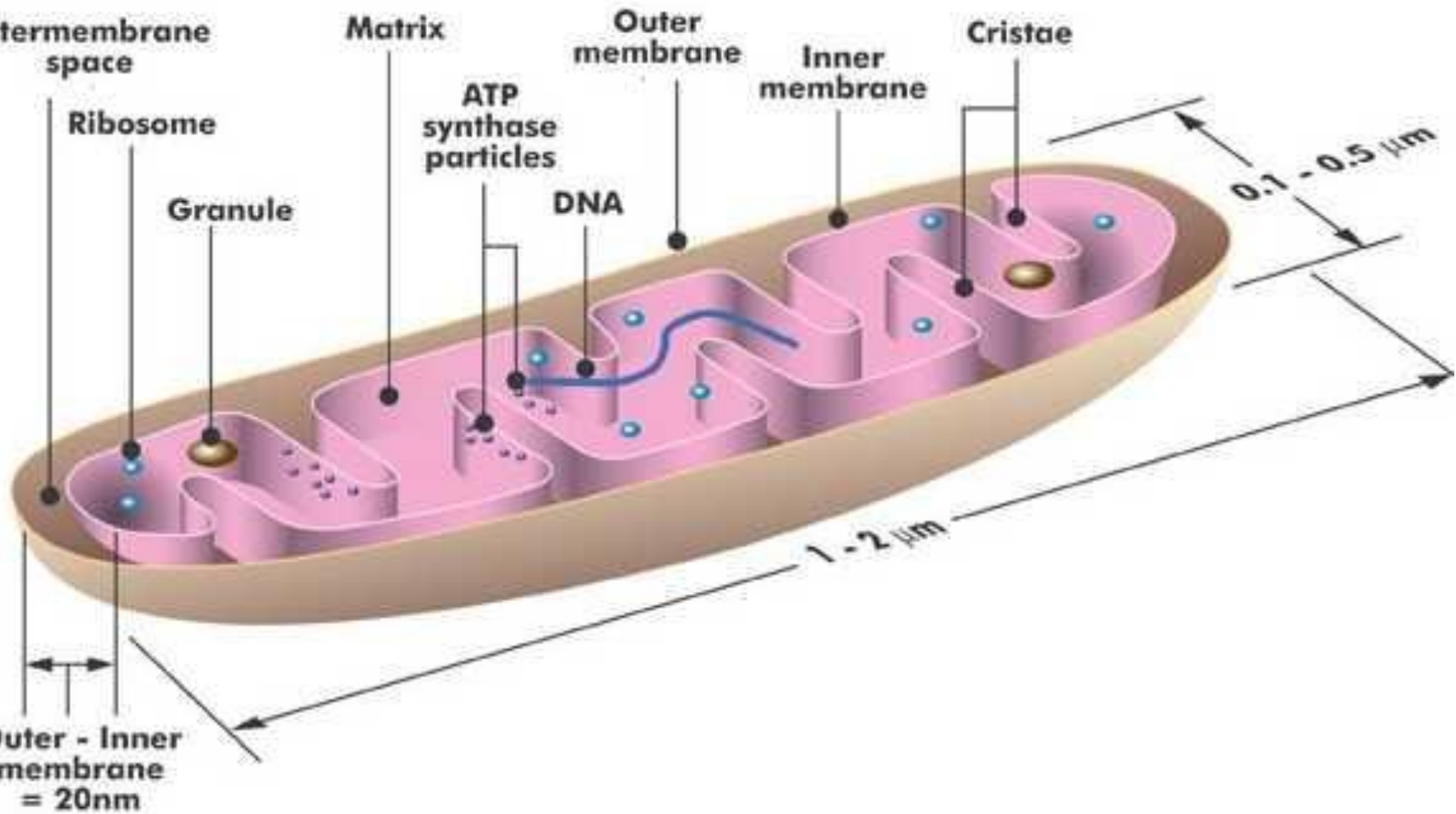
Outer membrane

Inner membrane

Cristae

0.1 - 0.5  $\mu\text{m}$

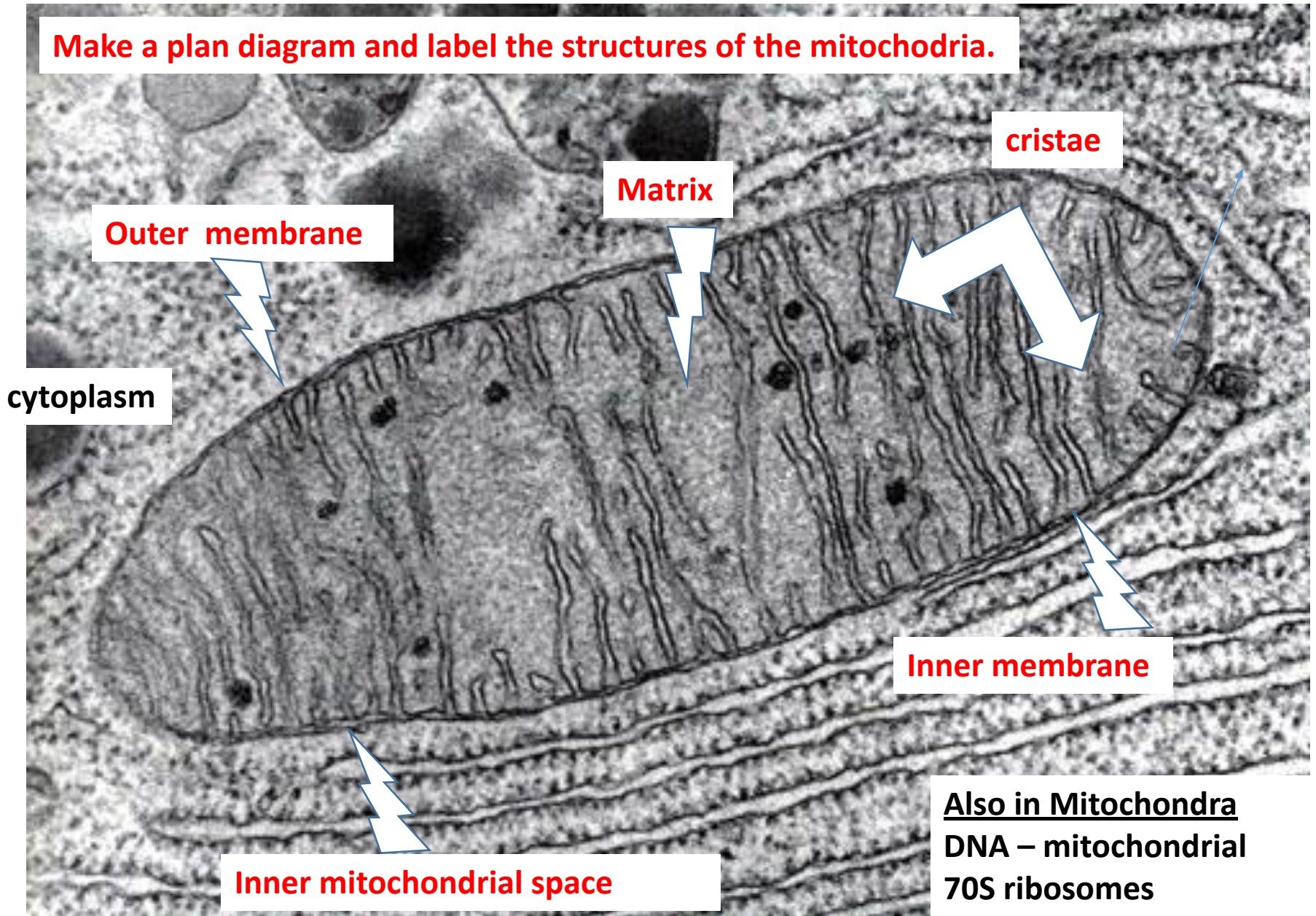
1 - 2  $\mu\text{m}$

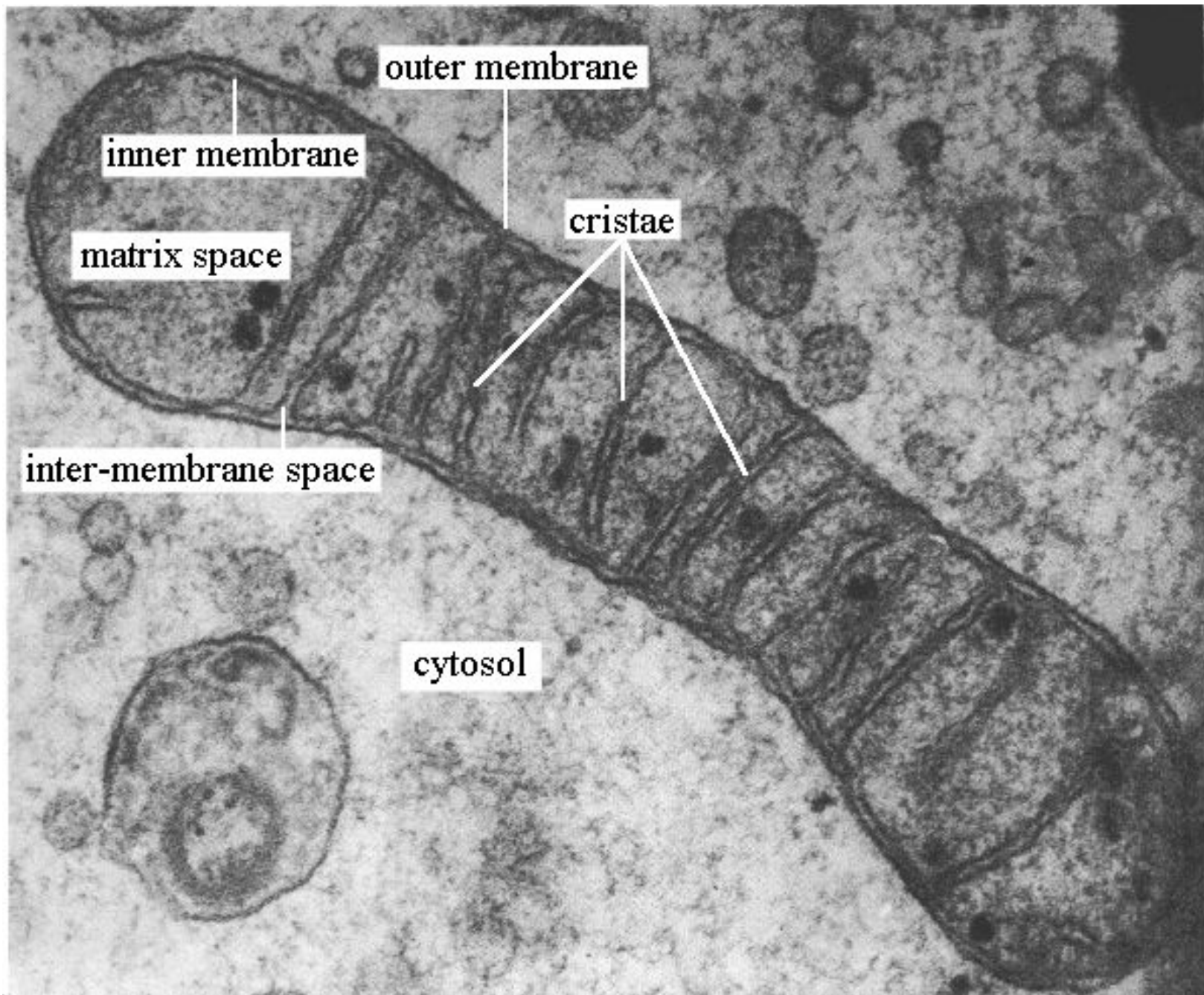


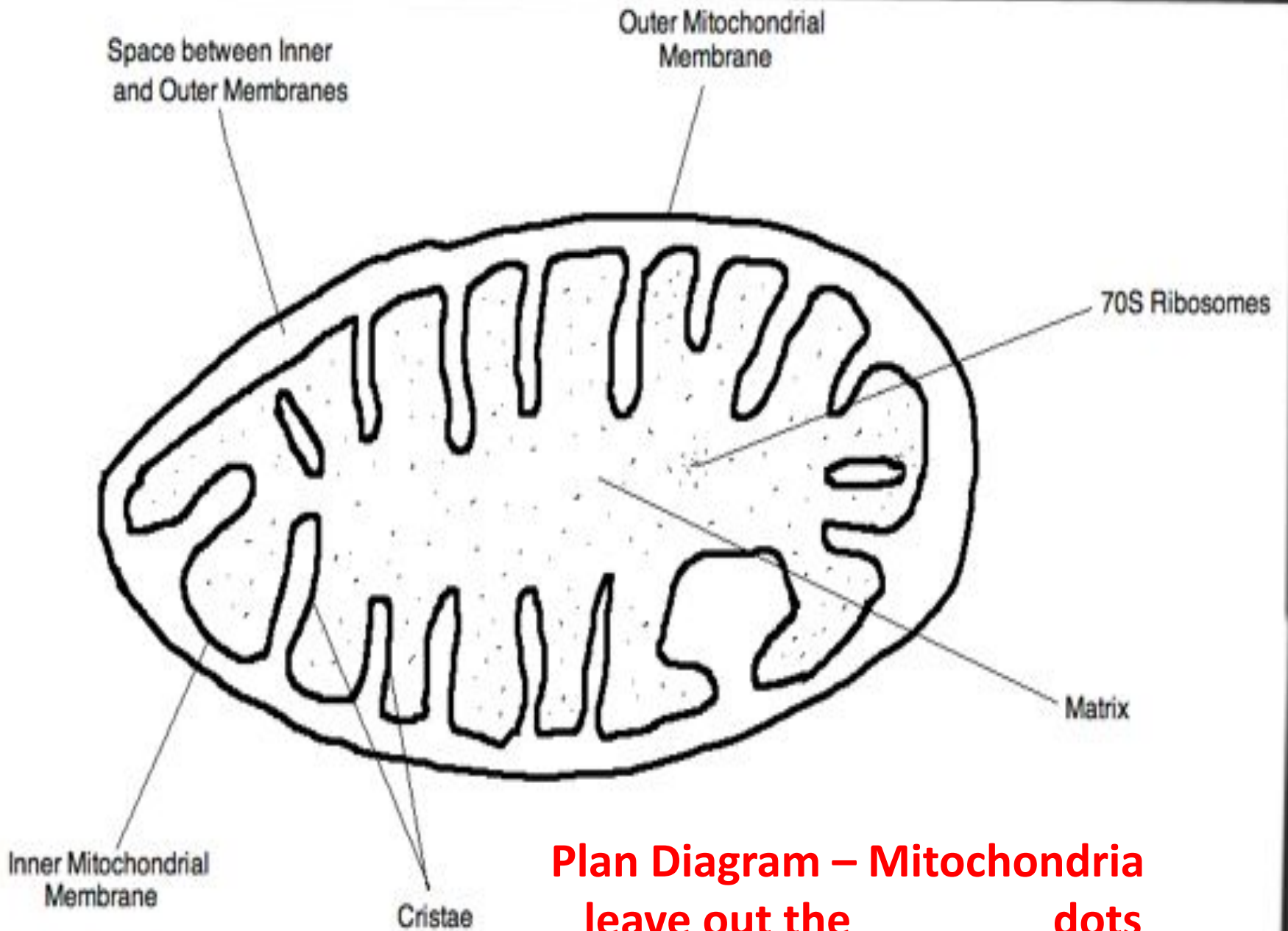
# Electron Micrograph of Mitochondria



**Make a plan diagram and label the structures of the mitochondria.**







**Plan Diagram – Mitochondria  
leave out the ..... dots**