Cellular Respiration

Part 1

Learning Objectives

- Explain what cellular respiration is and where it occurs

- Write the balanced chemical equation for cellular respiration

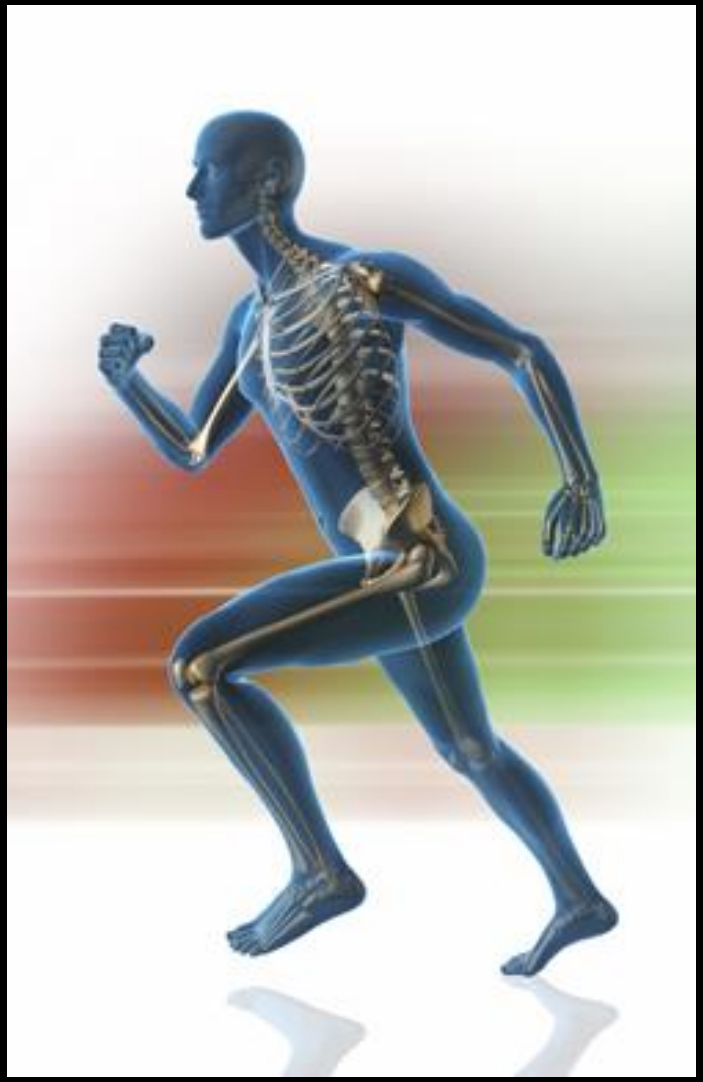

IRVING
2

Where does the energy that living things need come from?

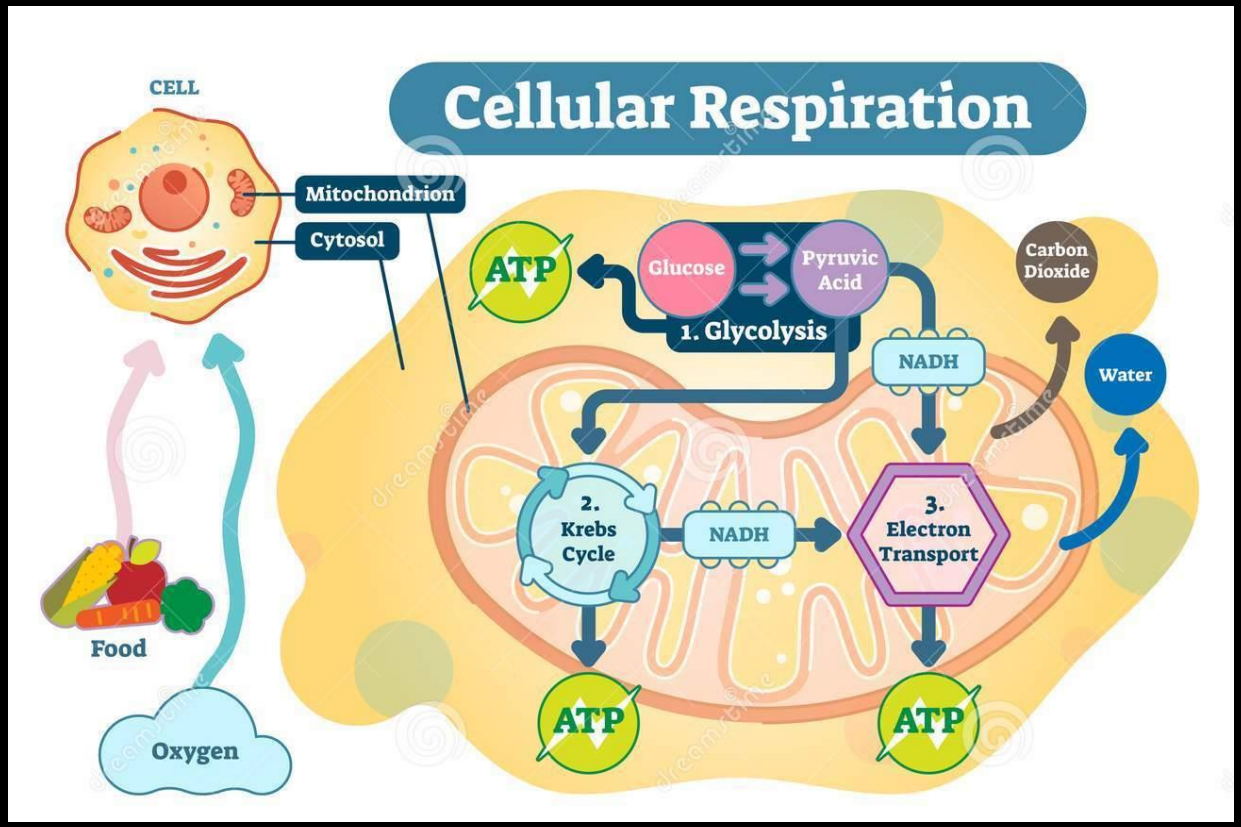
Why do you need to eat food?

- Energy for daily activities.

- Cells in your body convert chemical energy (glucose) into Adenosine Triphosphate (ATP)

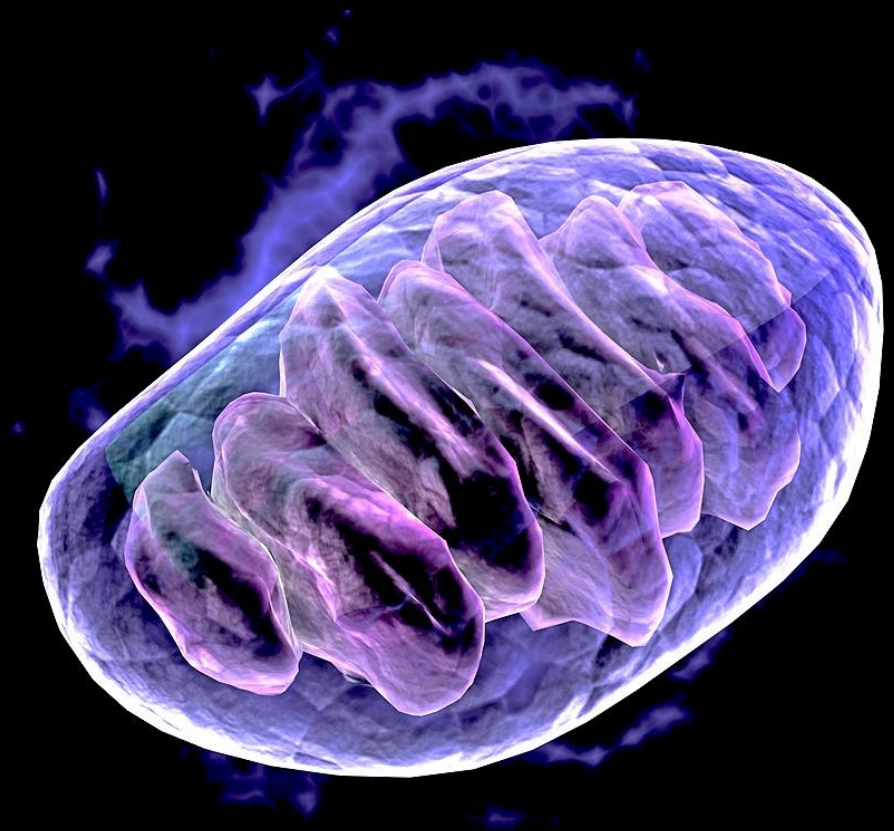


Cellular Respiration



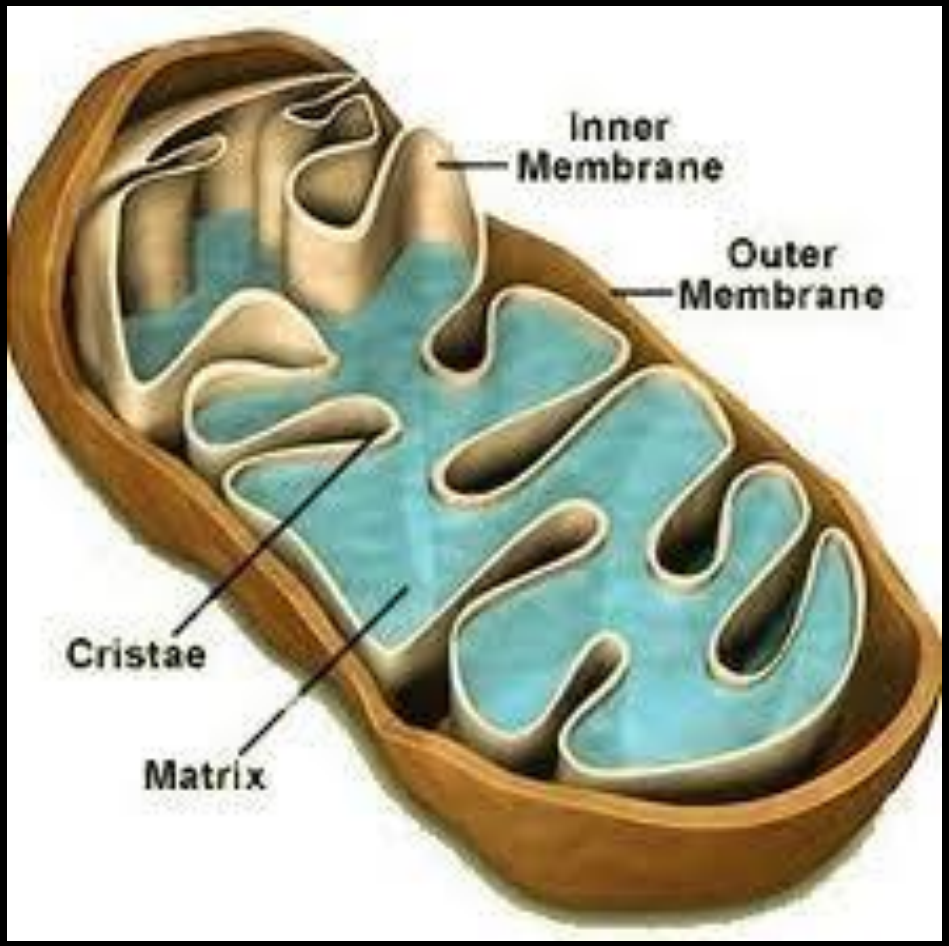
Cellular respiration is the process that releases energy by breaking down glucose in the presence of oxygen.

Where does it occur?



Cellular respiration occurs in the mitochondria

Mitochondrial Structure



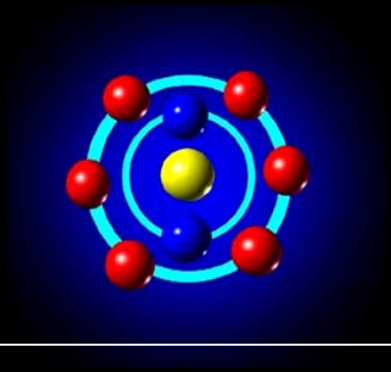
Outer membrane – encloses the mitochondria

Inner membrane – folds many times to make cristae

Cristae – site of ATP production

Matrix – fluid contained in the mitochondria

The Balanced Chemical Equation for Cellular Respiration

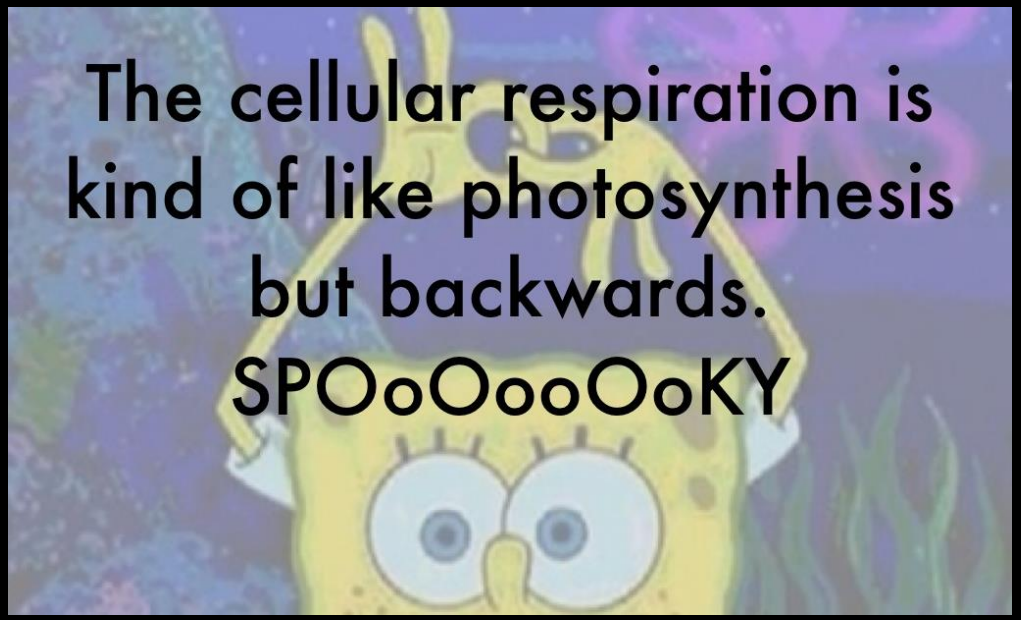



Glucose oxygen water carbon dioxide energy

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ H_20 + 6\ CO_2 + ATP$

(Reactants) (Products)

$C_6H_{12}O_6 + 6\ O_2 \longrightarrow 6\ H_20 + 6\ CO_2 + ATP$



$$6\ H_20 + 6\ CO_2 \xrightarrow{\text{Sunlight}} C_6H_{12}O_6 + 6\ O_2$$

YouTube
Mitochondria
Structure & Function

Stop Here

Cellular Respiration

Part 2

Learning Objectives

- Describe the 3 steps of cellular respiration

- Explain the process of glycolysis

Aerobic vs. Anaerobic

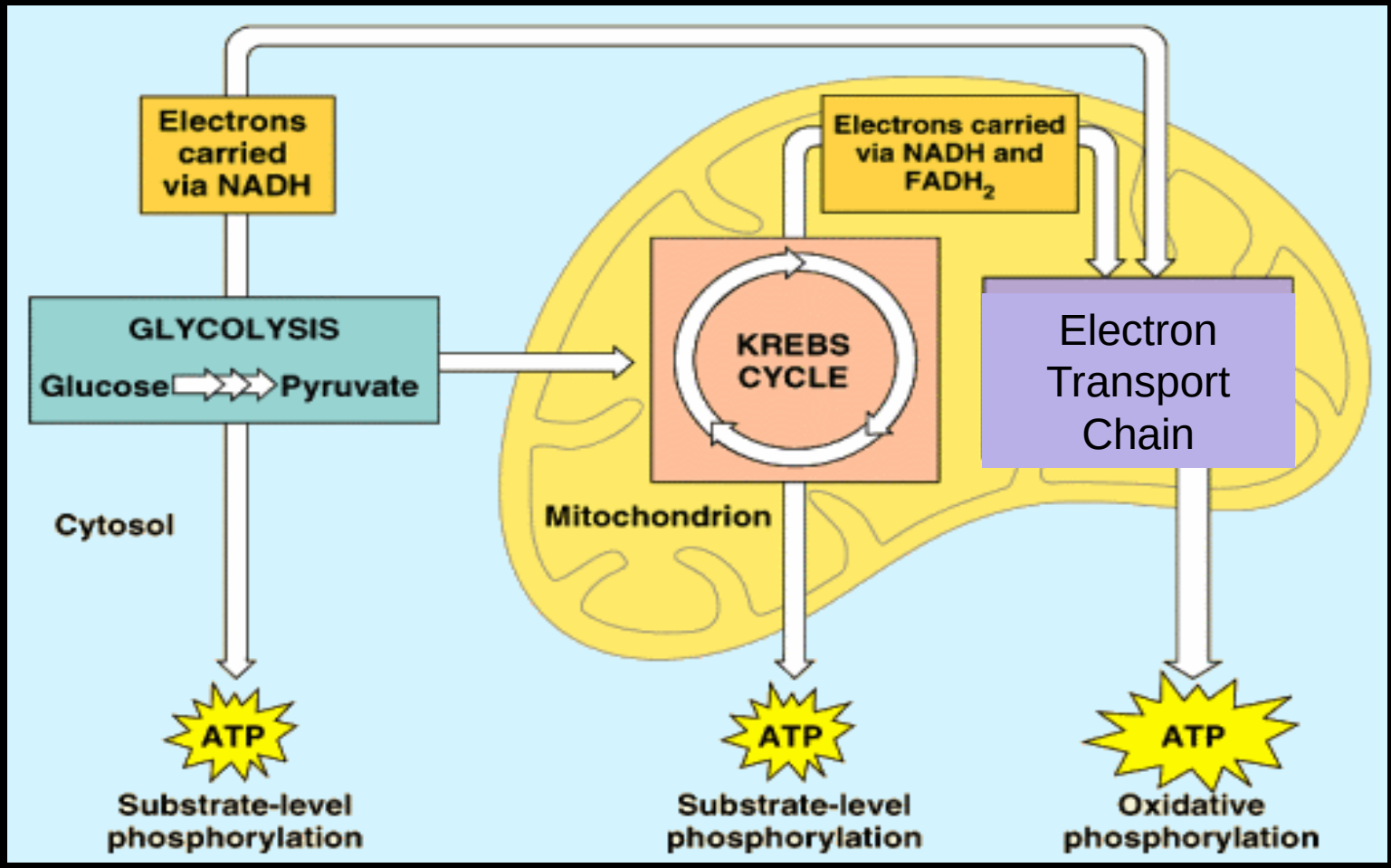
Aerobic:
Requiring oxygen

Anaerobic:
Without oxygen

3 Steps of Cellular Respiration

- Step 1 - Glycolysis
- Step 2 - Krebs Cycle
- Step 3 - Electron Transport Chain

3 Steps of Cellular Respiration



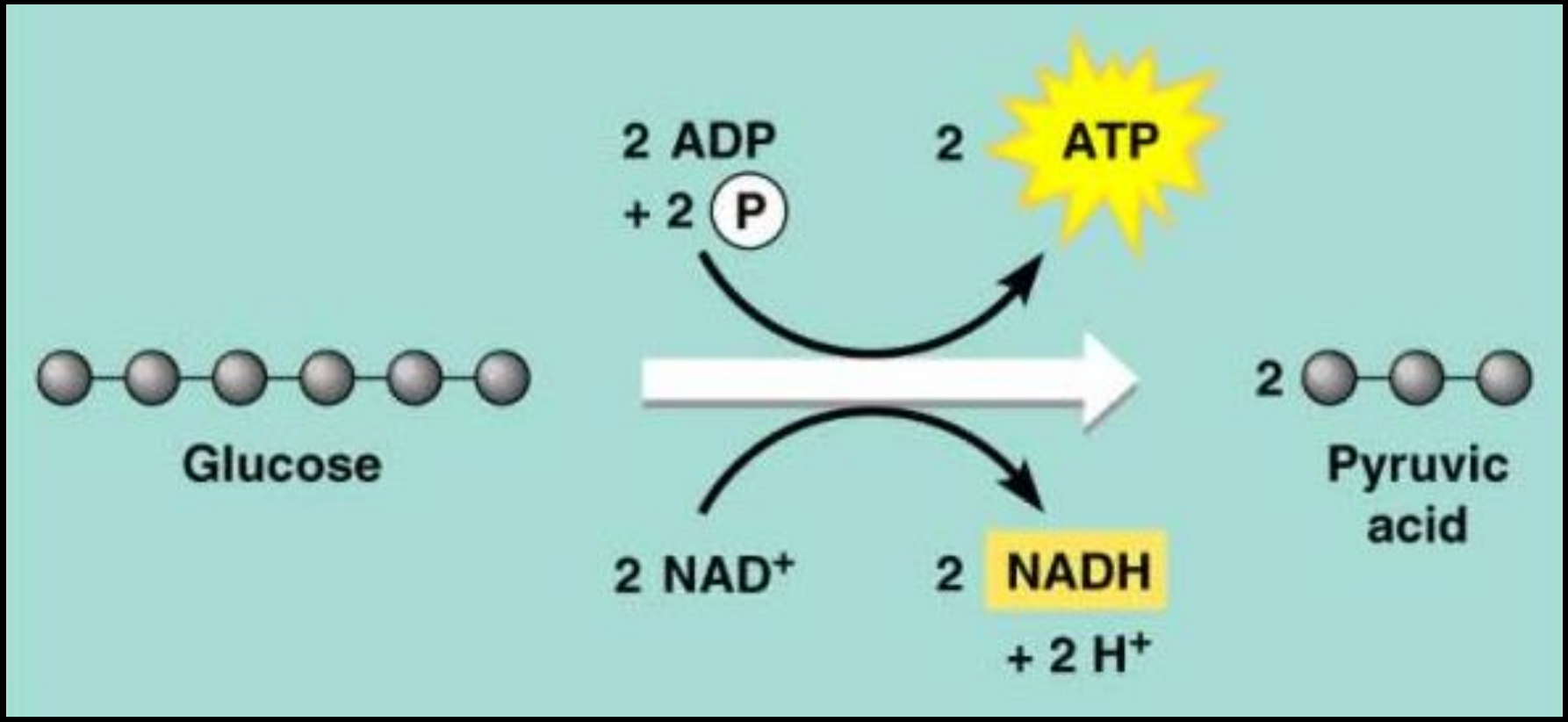
Glycolysis

Krebs Cycle

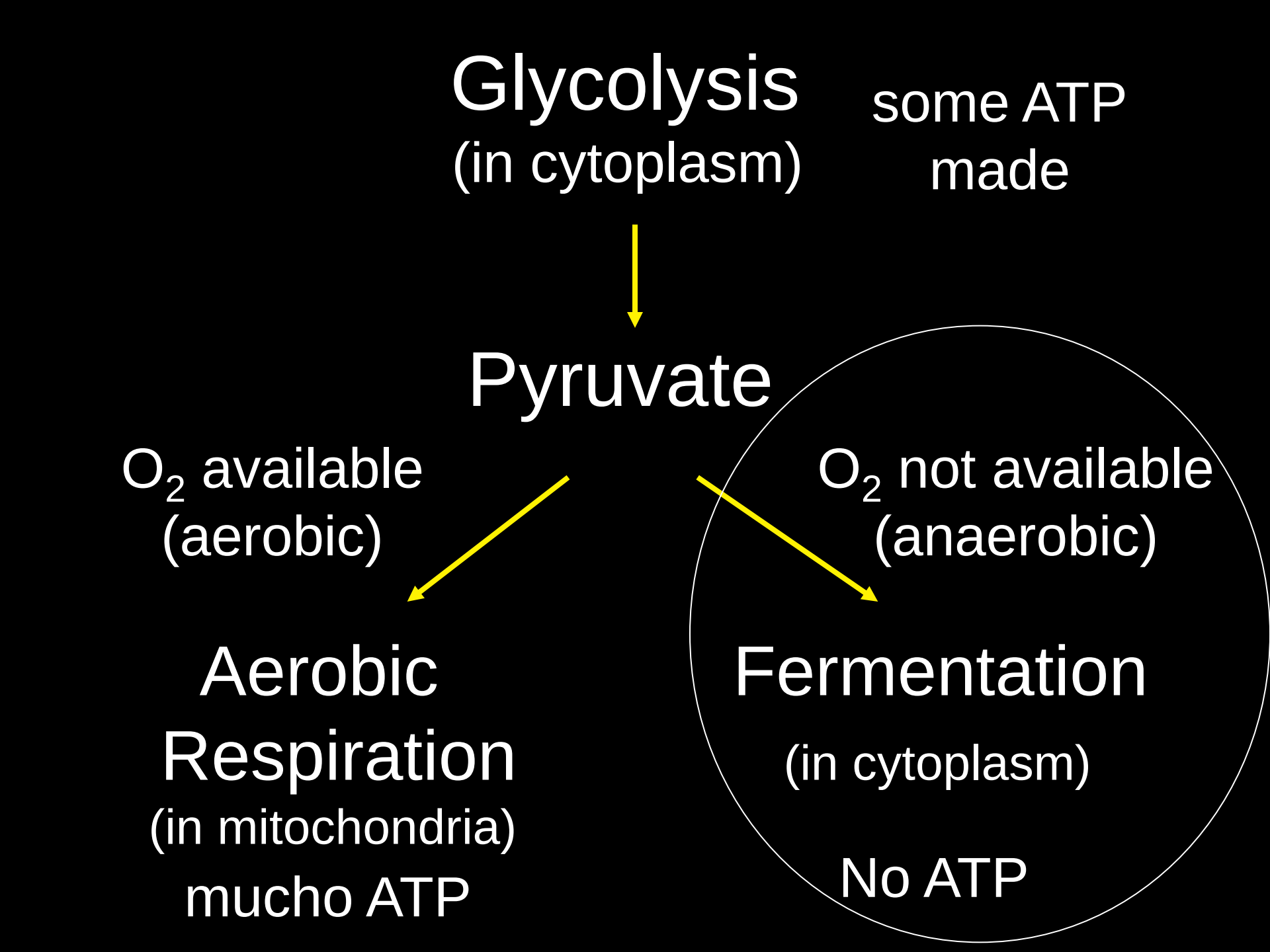
Electron Transport Chain

Glycolysis -

Occurs in cytoplasm
No oxygen required (anaerobic)



- Glucose is split in half producing 2 pyruvic acid
- 2 ATP and 2 NADH are produced


Glycolysis
(in cytoplasm)
some ATP made
Pyruvate
O_2 available (aerobic)
O_2 not available (anaerobic)
Aerobic Respiration
(in mitochondria)
mucho ATP
Fermentation
(in cytoplasm)
No ATP

Fermentation

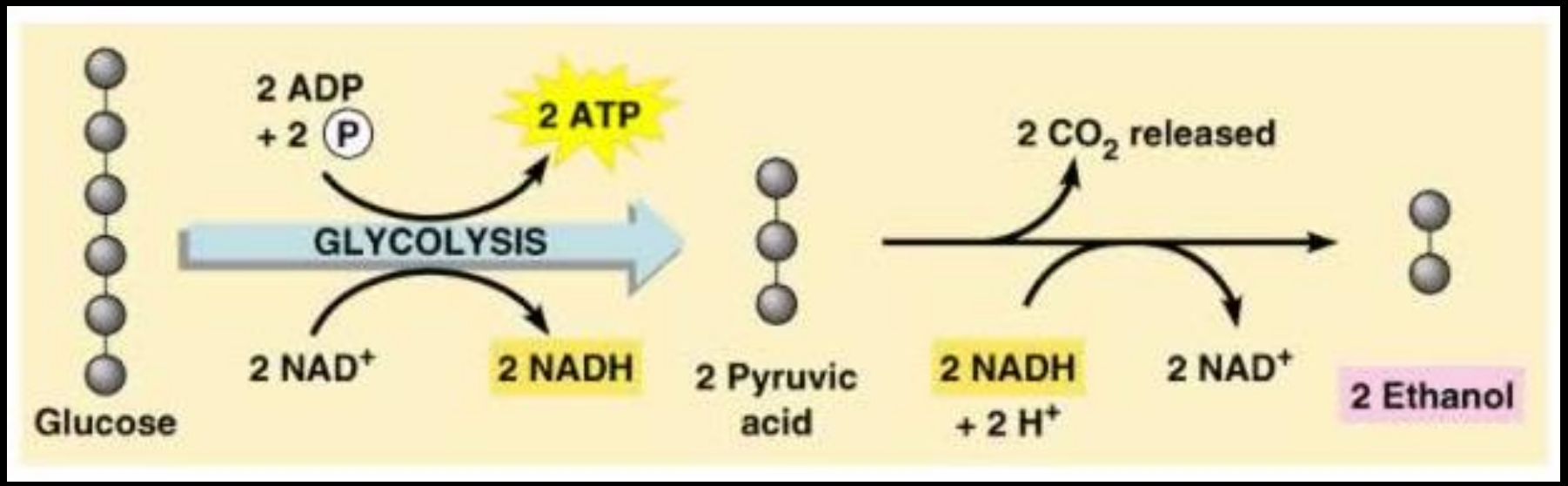
Occurs in the cytoplasm under anaerobic conditions

Two types

Alcoholic Fermentation

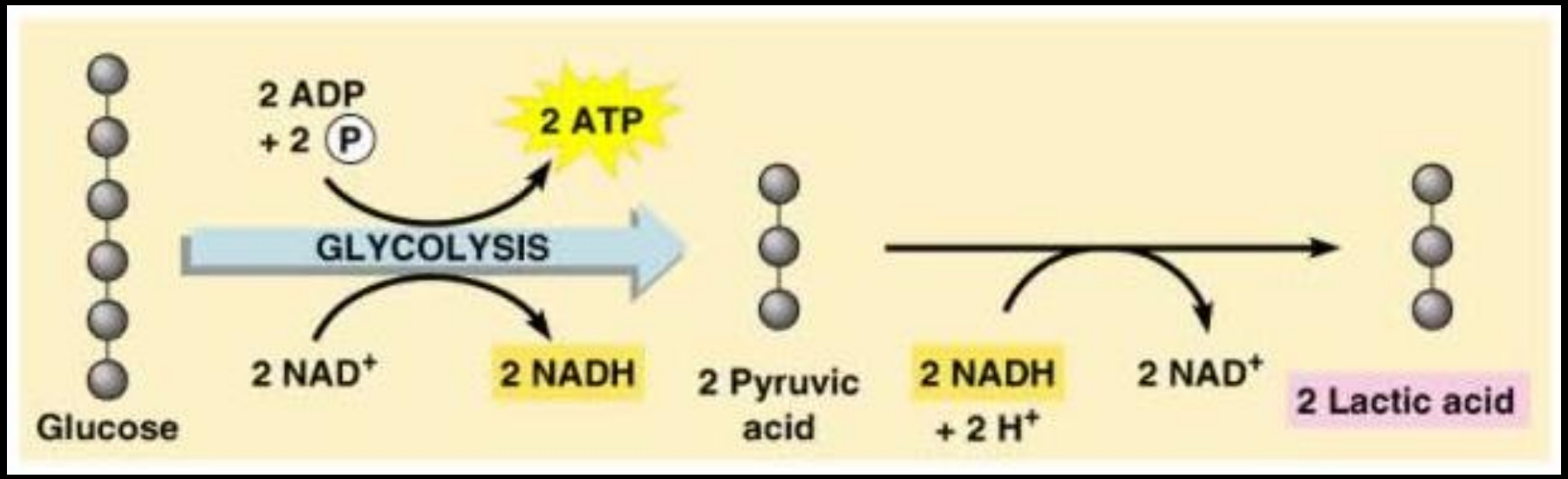
Lactic Acid Fermentation

Alcoholic Fermentation



Pyruvic Acid + NADH → Alcohol + CO_2 + NAD^+

Lactic Acid Fermentation



Pyruvic Acid + NADH → Lactic Acid + NAD^+

YouTube
Food Fermentation

Stop Here

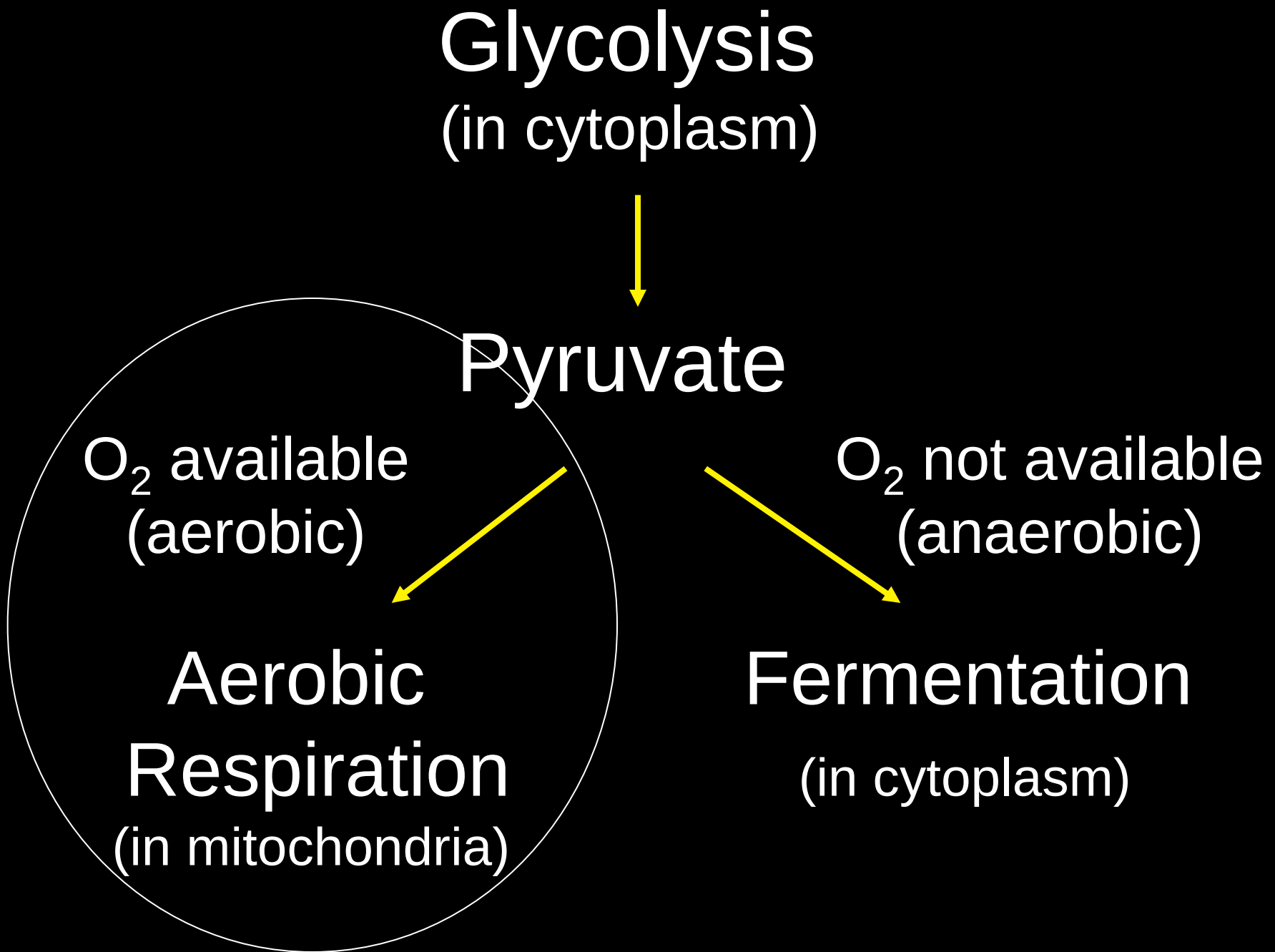
Cellular Respiration

Part 3

Learning Objectives

- Describe the process of the Krebs cycle

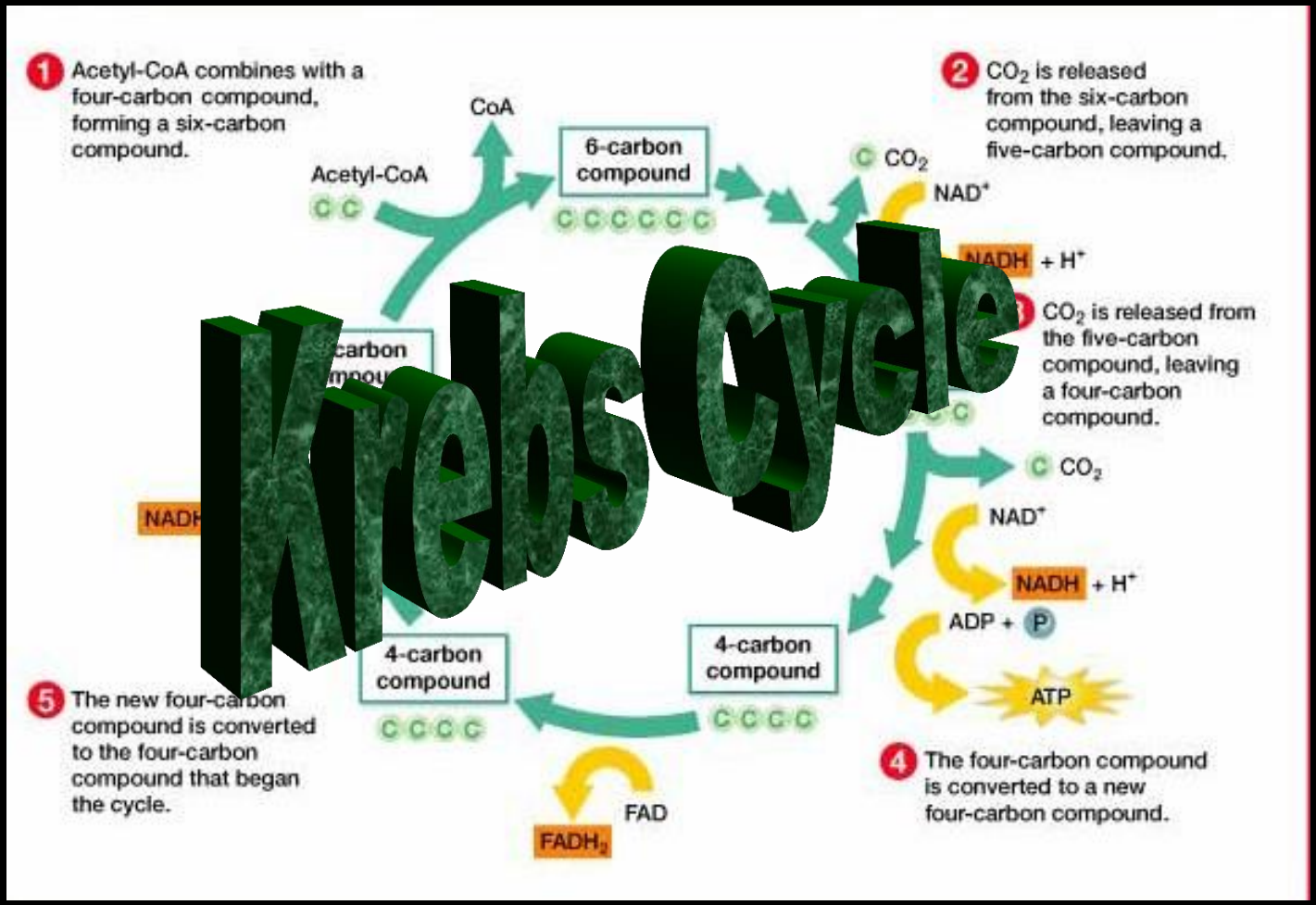
- Explain how energy made during the Krebs cycle is used during the electron transport chain to make ATP


Glycolysis
(in cytoplasm)
Pyruvate
O_2 available
(aerobic)
O_2 not available
(anaerobic)
Aerobic
Respiration
(in mitochondria)
Fermentation
(in cytoplasm)

Aerobic Respiration

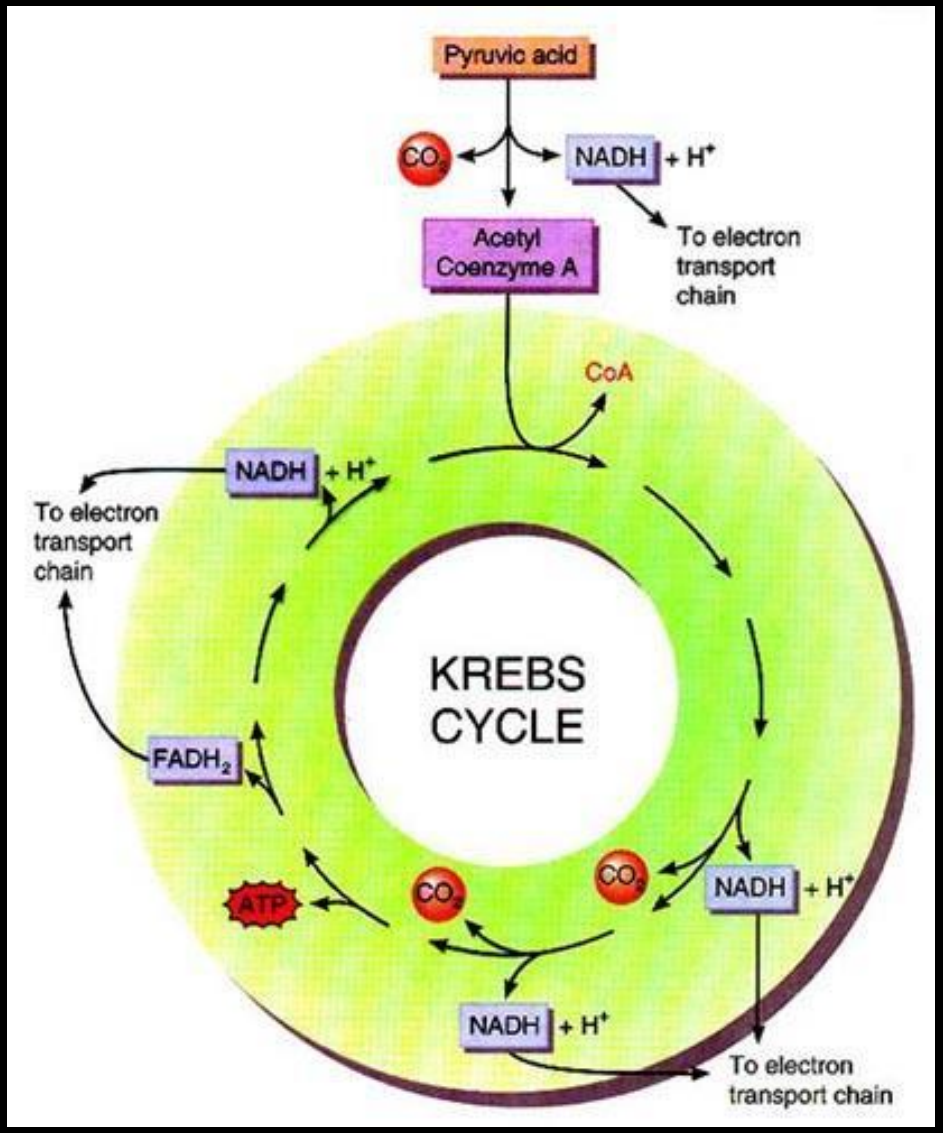
Energy-releasing pathways within cells require oxygen, which is why we breathe.

Step 2 of Cellular Respiration



Krebs Cycle

Occurs in mitochondrial matrix
Oxygen required (aerobic)



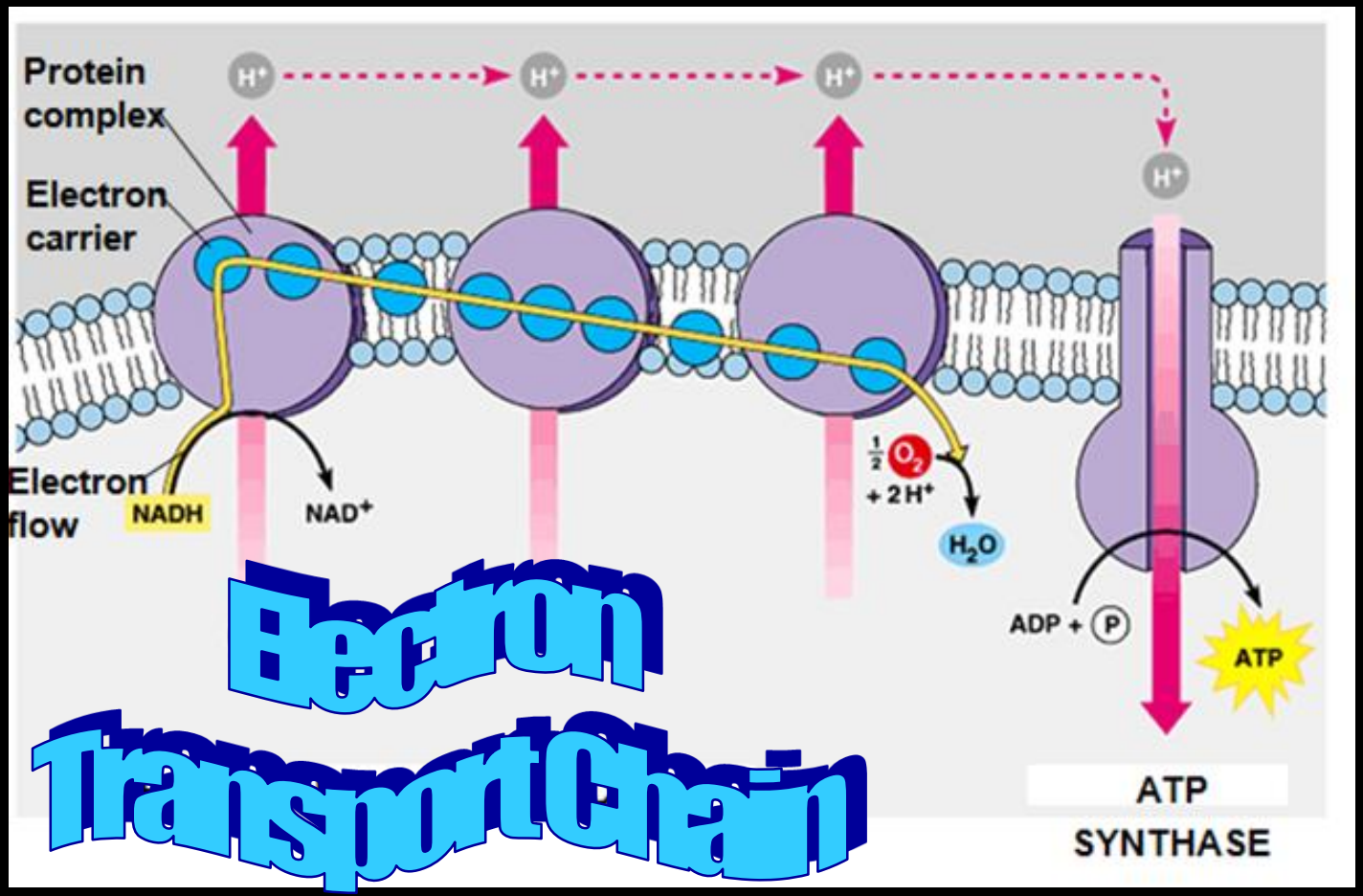
From 2 pyruvic acid you get:

- 2 ATP - used by cells
- 6 CO_2 - expelled
- NADH & $FADH_2$ – electron-carrying molecules for next stage

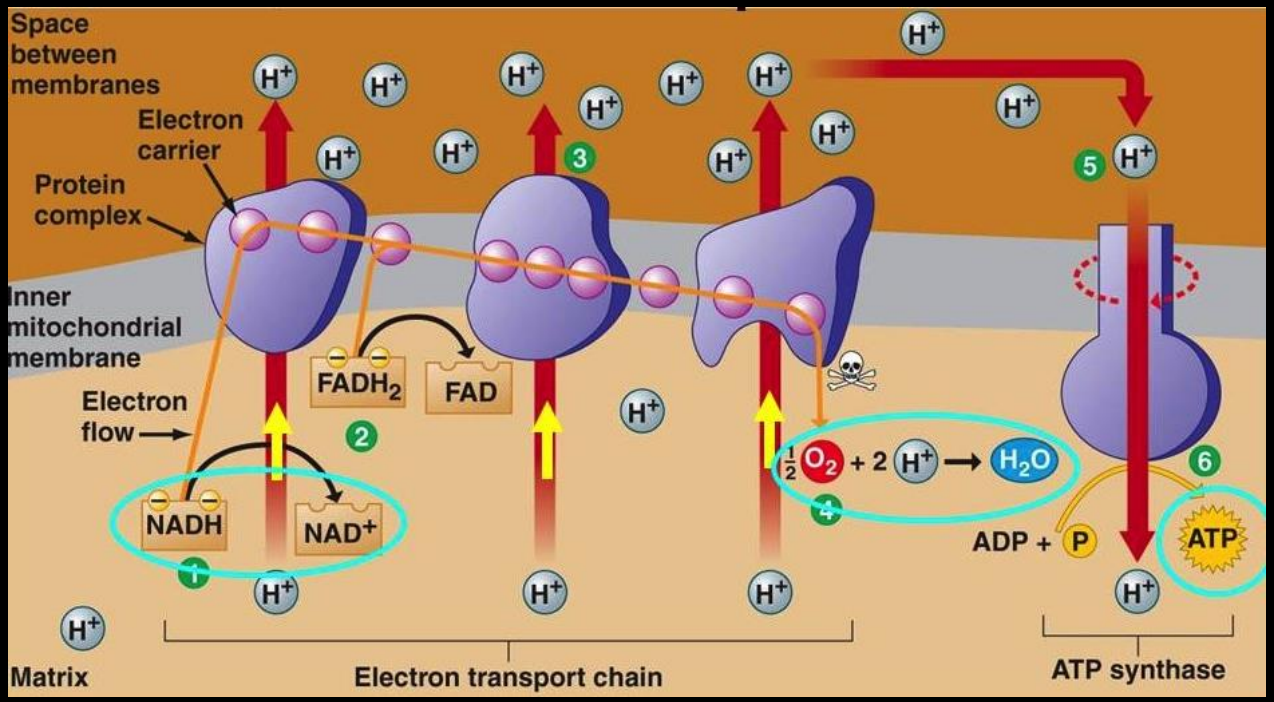
The Main Function of the Krebs Cycle

To make electron carriers for the Electron Transport Chain

Step 3 of Cellular Respiration



Electron Transport Chain

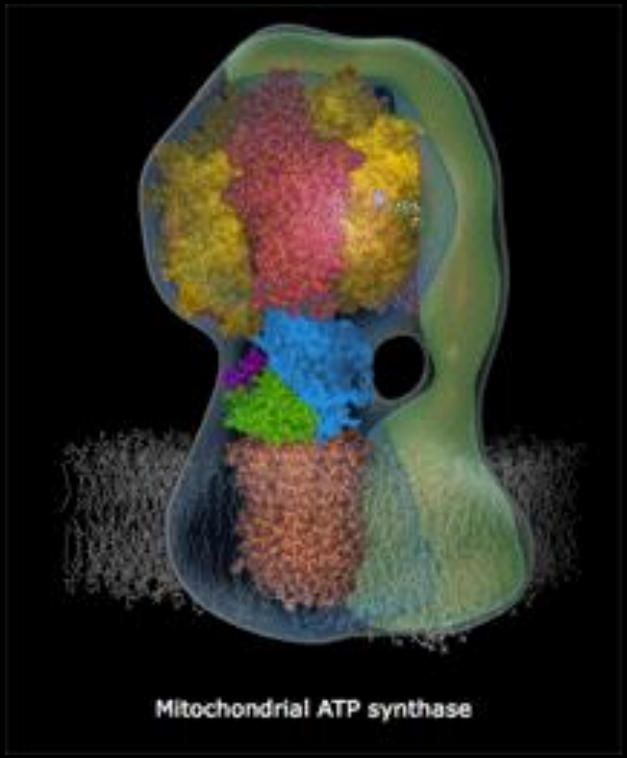


From electrons and 6 oxygen you get:

- 6 H_2O
- 32 - 34 ATP

NADH & $FADH_2$ are transferred to a chain of proteins and large amounts of ATP are made.

Function of the Electron Transport Chain

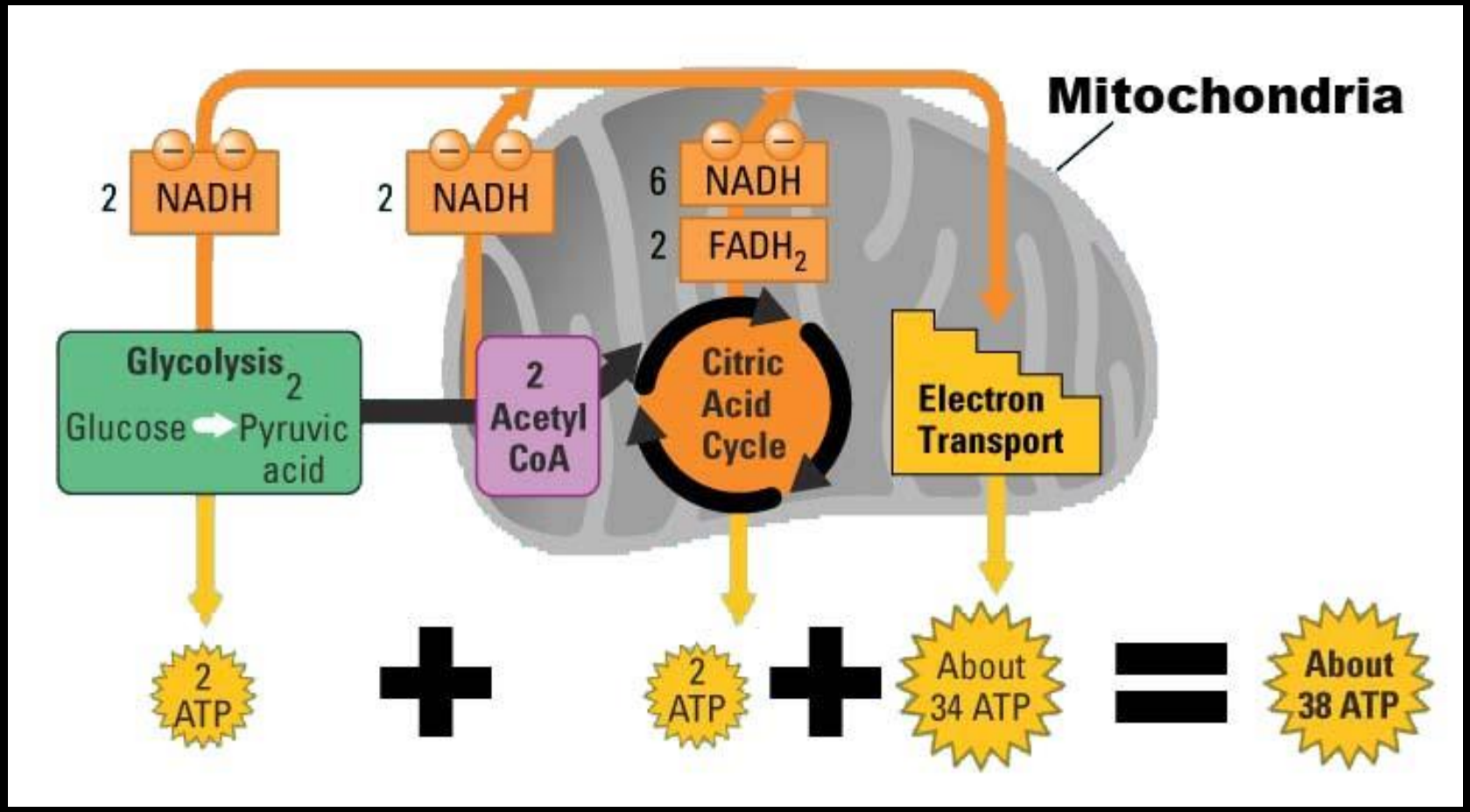


ATP Synthase attaches a phosphate to ADP to make ATP

YouTube Video

ATP Synthase

How much ATP is made from one glucose molecule?



Glycolysis	+	Krebs Cycle	+	ETC	=	Total
2 ATP		2 ATP		34 ATP		38 ATP

YouTube Video

Cellular Respiration
Amoeba Sisters

Stop Here

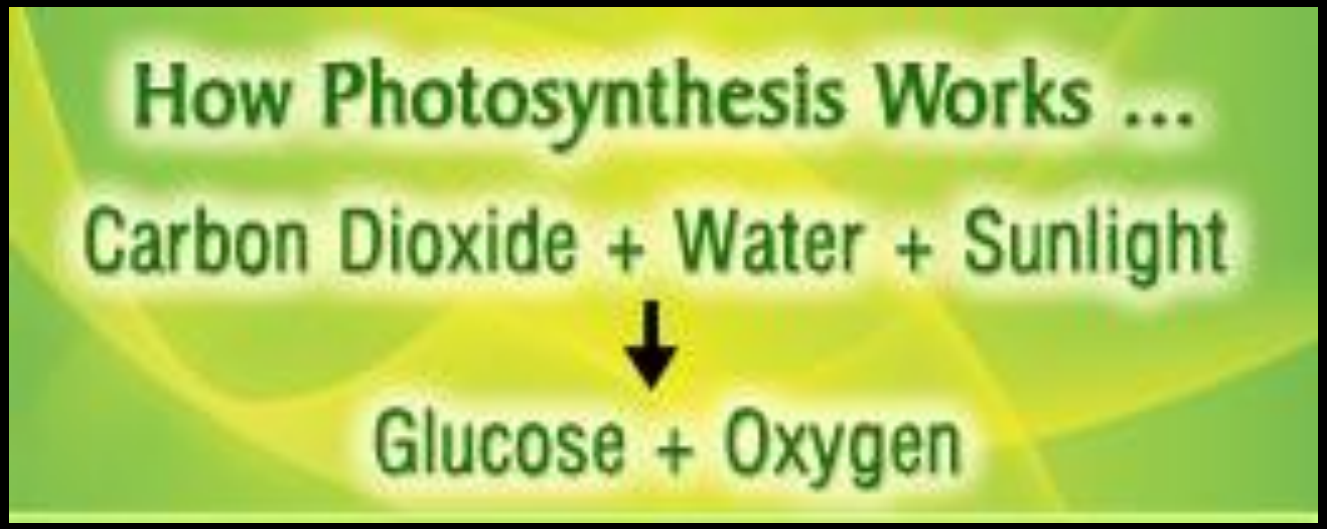
How is energy from food measured?

1000 **c**alories = 1 **C**alorie

Energy in food is converted to heat

The amount of heat needed to raise the temperature of 1 gram of water by 1 degree Celsius = 1 calorie

What is the relationship between the green box and blue box?



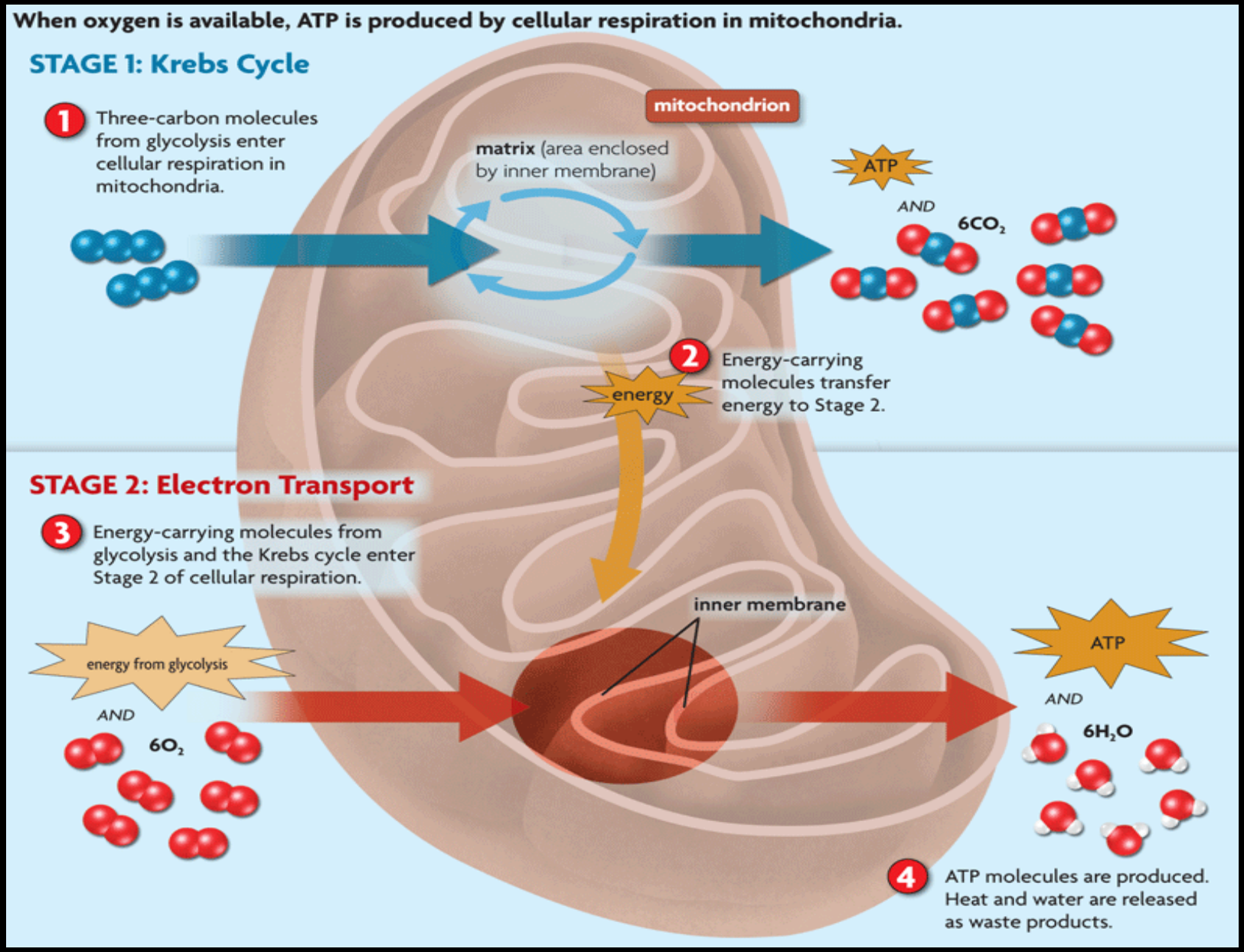
← Reactant

← Product

← Reactant

← Product

Let's Review


When oxygen is available, ATP is produced by cellular respiration in mitochondria.
STAGE 1: Krebs Cycle
1 Three-carbon molecules from glycolysis enter cellular respiration in mitochondria.
mitochondrion
matrix (area enclosed by inner membrane)
ATP
AND
6CO2
2 Energy-carrying molecules transfer energy to Stage 2.
energy
STAGE 2: Electron Transport
3 Energy-carrying molecules from glycolysis and the Krebs cycle enter Stage 2 of cellular respiration.
inner membrane
energy from glycolysis
AND
6O2
ATP
AND
6H2O
4 ATP molecules are produced. Heat and water are released as waste products.