Cellular Respiration and Fermentation
Nearly all the cells in our body (all living organisms including animals and plants) break down sugars for ATP production.

There are two important ways a cell can harvest energy from food: **cellular respiration** and **fermentation**.
The fuel for respiration ultimately comes from photosynthesis

- All organisms have the ability to harvest energy from organic molecules using cellular respiration or fermentation, however only plants manufacture these molecules from inorganic sources by the process of photosynthesis.
The human body uses energy from ATP for all its activities. It powers almost all cell and body activities.
Most cells of most organisms harvest energy **aerobically** (with oxygen). This aerobic harvesting of energy from sugar is called **cellular respiration**.

Cellular respiration yields CO$_2$, H$_2$O, and a 36-38 ATPs.
Steps of Aerobic Cellular Respiration

Aerobic Cellular Respiration has three steps.

1. Glycolysis: Cytoplasm
2. Kreb’s Cycle: Mitochondria
3. Electron Transport Chain: Mitochondria
Glucose undergoes glycolysis in the cytoplasm, producing 2 ATP, 2 pyruvate, and 2 CO₂.

Pyruvate can undergo fermentation, producing lactate or ethanol and 2 CO₂.

Cellular respiration occurs in the mitochondrion, involving the Krebs cycle, electron carriers, and the electron transport chain.

The Krebs cycle produces 2 acetyl CoA, which are converted into 4 CO₂.

The electron carriers and the electron transport chain produce 32 or 34 ATP.

O₂ is consumed, and H₂O is produced.

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Aerobic Cellular Respiration starts with the process of **glycolysis:** the breakdown or splitting of glucose (6 carbons) into two 3-carbon molecules called **pyruvic acid.**

- Glucose +2 ATP $\rightarrow$ Pyruvic Acid + 4ATP

- This process requires the input of 2 ATP to activate the process.
What Happens During Cellular Respiration?

- The Krebs Cycle Breaks Down Pyruvate in the Mitochondrial Matrix.

- Oxygen plays the main role on ATP production. The Electron Transport Chain that is Oxygen driven, produces the largest amount of ATP produced in the process.
Balance

- For each glucose molecule that enters the process of Glycolysis, there is a total net production of 36-38 ATP’s.
Some cells harvest energy *anaerobically* (without oxygen). This anaerobic harvesting of energy from sugar is called *fermentation* and it yields CO$_2$, 2 ATPs and another bioproduct.
Let’s back up a little. Both processes, Aerobic cellular respiration and fermentation start with the same first step: the process of **glycolysis**: the breakdown or splitting of glucose (6 carbons) into two 3-carbon molecules called **pyruvic acid**.

However, the presence or absence of oxygen will determine which one of the two pathways (respiration or fermentation) will be taken next.
Under anaerobic conditions, many kinds of cells can use glycolysis alone to produce small amounts of ATP. The resulting pyruvic acid will then be breakdown into a waste product and CO2.
Different organisms produce different waste products. For example *Lactobacillus acidophilus*, uses the galactose of milk, transforms it into glucose and after glycolysis, it ferments the pyruvic acid into Lactic acid, the main component of yogurt. This is known as **Lactic acid fermentation**.

Baker’s yeast, *Saccharomyces cerevisiae*, uses starch, hydrolysis it to glucose and then after glycolysis, it ferments the pyruvic acid into Ethanol or drinking alcohol. This is the basic chemical principle behind bread making and alcoholic beverage production. It is known as **alcoholic fermentation**.
In alcoholic fermentation, pyruvic acid is converted to CO$_2$ and ethanol.

Alcoholic fermentation is used in the industry for the production of wine and beer.

Fabulous fermentation!

Yum… indeed! shame we got a text next class!