Photosynthesis and cellular respiration provide energy for life

Breathing supplies oxygen to our cells for use in cellular respiration and removes carbon dioxide
Cellular respiration banks energy in ATP molecules

\[ \text{Glucose} + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{ATP} \]

The human body uses energy from ATP for all its activities

- Kilocalories (kcal)- An Energy unit, the quantity of heat required to raise the temperature of 1 kilogram (kg) of water by 1 degree Celsius.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Kcal Consumed per Hour by a 67.5 kg (149-lb) Person*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running (7 mph)</td>
<td>470</td>
</tr>
<tr>
<td>Dancing (fast)</td>
<td>310</td>
</tr>
<tr>
<td>Bicycling (10 mph)</td>
<td>490</td>
</tr>
<tr>
<td>Swimming (2 mph)</td>
<td>436</td>
</tr>
<tr>
<td>Walking (3 mph)</td>
<td>245</td>
</tr>
<tr>
<td>Dancing (slow)</td>
<td>204</td>
</tr>
<tr>
<td>Sitting (sitting)</td>
<td>28</td>
</tr>
</tbody>
</table>

*Not including food needed for body maintenance

Cells tap energy from electrons “falling” from organic fuels to oxygen

\[ \text{Glucose} + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O} + \text{ATP} \]
Redox reaction occurring simultaneously

\[ \text{H}_{2}\text{O} \xrightarrow{\text{Oxidation}} \text{O} + 2\text{H} \]

\[ \text{NAD}^+ + 2\text{H} \xrightarrow{\text{Reduction}} \text{NADH} + \text{H}^+ \]
(carries 2 electrons)

Overview: Cellular respiration occurs in three main stages

Glycolysis harvests chemical energy by oxidizing glucose to pyruvate
Energy investment phase

Pyruvate is chemically groomed for the citric acid cycle

Energy payoff phase
The citric acid cycle completes the oxidation of organic molecules, generating many NADH and FADH2 molecules.

Most ATP production occurs by oxidative phosphorylation.

Certain poisons interrupt critical events in cellular respiration.
Review: Each molecule of glucose yields many molecules of ATP

Fermentation enables cells to produce ATP without oxygen

Glycolysis evolved early in the history of life on earth

- Glycolysis is the universal energy-harvesting process of life
- Significant levels of O2 did not accumulate in the atmosphere until about 2.7 billions years ago
- For almost a billion years, prokaryotes must have generated ATP exclusively from glycolysis, because it does not require O2
Cells use many kinds of organic molecules as fuel for cellular respiration

Food molecules provide raw materials for biosynthesis