### TABLE 5.5
**Aerobic Respiration, Anaerobic Respiration, and Fermentation Compared**

<table>
<thead>
<tr>
<th>Energy-Producing Process</th>
<th>Growth Conditions</th>
<th>Final Hydrogen (Electron) Acceptor</th>
<th>Type of Phosphorylation Used to Generate ATP</th>
<th>ATP Molecules Produced per Glucose Molecule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobic respiration</td>
<td>Aerobic</td>
<td>Molecular oxygen ((O_2))</td>
<td>Substrate-level and oxidative</td>
<td>36 or 38*</td>
</tr>
<tr>
<td>Anaerobic respiration</td>
<td>Anaerobic</td>
<td>Usually an inorganic substance (such as (NO_3^-), (SO_4^{2-}), or (CO_3^{2-})), but not molecular oxygen ((O_2))</td>
<td>Substrate-level and oxidative</td>
<td>Variable (fewer than 38 but more than 2)</td>
</tr>
<tr>
<td>Fermentation</td>
<td>Aerobic or anaerobic</td>
<td>An organic molecule</td>
<td>Substrate-level</td>
<td>2</td>
</tr>
</tbody>
</table>

*In prokaryotic aerobic respiration, 38 ATP molecules are produced; in eukaryotic aerobic respiration, 36 ATP molecules are produced.
Flow Overview

- **Food**
  - proteins
  - carbohydrates
  - lipids

- **glucose**
  - Fructose-1,6-bisphosphate

- **pyruvate**
  - anaerobic homolactic fermentation
  - aerobic oxidation
  - anaerobic alcoholic fermentation

- **citric acid cycle**
  - oxidative phosphorylation

- lactate
- carbon dioxide water
- carbon dioxide ethanol

**Glycolysis**
Locations
### Table 5.3

**ATP Yield During Prokaryotic Aerobic Respiration of One Glucose Molecule**

<table>
<thead>
<tr>
<th>Source</th>
<th>ATP Yield (Method)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Glycolysis</strong></td>
<td></td>
</tr>
<tr>
<td>1. Oxidation of glucose to pyruvic acid</td>
<td>2 ATP (substrate-level phosphorylation)</td>
</tr>
<tr>
<td>2. Production of 2 NADH</td>
<td>6 ATP (oxidative phosphorylation in electron transport chain)</td>
</tr>
<tr>
<td><strong>Preparatory Step</strong></td>
<td></td>
</tr>
<tr>
<td>1. Formation of acetyl CoA produces 2 NADH</td>
<td>6 ATP (oxidative phosphorylation in electron transport chain)</td>
</tr>
<tr>
<td><strong>Krebs Cycle</strong></td>
<td></td>
</tr>
<tr>
<td>1. Oxidation of succinyl CoA to succinic acid</td>
<td>2 GTP (equivalent of ATP; substrate-level phosphorylation)</td>
</tr>
<tr>
<td>2. Production of 6 NADH</td>
<td>18 ATP (oxidative phosphorylation in electron transport chain)</td>
</tr>
<tr>
<td>3. Production of 2 FADH</td>
<td>4 ATP (oxidative phosphorylation in electron transport chain)</td>
</tr>
<tr>
<td><strong>Total:</strong> 38 ATP</td>
<td></td>
</tr>
</tbody>
</table>

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Glycolysis
Glucose

2 NADH
+2 H^+

2 Pyruvic acid

2 NADH
+2 H^+

Preparatory step

2 Acetyl CoA

2 CO₂

KREBS CYCLE

6 NADH
+6 H^+

4 CO₂

2 FADH₂

6 CO₂ (Total)

10 NADH
2 FADH₂
+10 H^+

(Total)

Electrons

Electron transport chain and chemiosmosis

6 O₂
+12 H^+

6 H₂O

2 ATP

34 ATP

38 ATP (Total)

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Anaerobics yield only 2 ATP
Overview - Potential Outcomes

Glycolysis:

- Glucose (C₆H₁₂O₆) → Pyruvate

Fermentation:

- Pyruvate → Ethanol (CH₃–CH₂OH) or Lactate (CH₃–CHOH–CH₃)

Complete Oxidation:

- Pyruvate → CO₂ + H₂O
cell wall (murein) → capsules → biofilms → storage → ATP, NAD, CoASH DNA, RNA Ribosomes

lipids → glucose → hexose phosphate → pentose phosphate → tetrose phosphate → nucleotides histidine

glycerol phosphate → phosphoglyceric acid → shikimic acid

cysteine → serine → phosphoenolpyruvic acid → tryptophan → tyrosine phenylalanine

dna rna → purines → glycine → pyruvic acid → alanine valine leucine

cytochromes → chlorophyll → hemes → porphyrin → fatty acids

isoleucine → lysine → aspartic acid → threonine methionine asparagine pyrimidines

dna rna → oxalacetic acid → citric acid → polyisoprenoid compounds → bacterial membrane archaeal membrane quinones

α-ketoglutaric acid → glutamic acid → glutamine → proline arginine