• How do organisms use Glucose (foods) for energy?

• Answer: Cellular Respiration

⇒ Overall simplified reaction:

✓ Ingredients: Glucose + O₂

✓ Products: CO₂ + H₂O + ATP (energy)

★ Reverse Photosynthesis
Cellular Respiration = “Breathing” at the cellular level

✓ $O_2$ is used by cells

✓ $CO_2$ is produced by cells
Function: **Refine “raw” stored energy**

- Carbohydrates, Lipids, Protein

Goal: **USABLE Cellular energy: ATP**

(Adenosine Tri-Phosphate)
Cell Respiration Occurs Continuously

- Cells NEED constant energy (ATP) to maintain cell function
  - ATP can NOT be stored
  - ATP MUST be produced on demand
  - Produced by breaking down stable stored organic molecules
• ~75% of all ATP is used for life sustaining processes

⇒ Basal Metabolic Rate: Energy needed to sustain body function

✓ 1,500 Cal/day or (Kcal/day)

• ATP also used for voluntary activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Kcal Consumed per Hour by a 67.5-kg (150-lb) Person*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicycling (racing)</td>
<td>514</td>
</tr>
<tr>
<td>Bicycling (slowly)</td>
<td>170</td>
</tr>
<tr>
<td>Dancing (slow)</td>
<td>202</td>
</tr>
<tr>
<td>Dancing (fast)</td>
<td>599</td>
</tr>
<tr>
<td>Driving a car</td>
<td>61</td>
</tr>
<tr>
<td>Eating</td>
<td>28</td>
</tr>
<tr>
<td>Gymnastics</td>
<td>186</td>
</tr>
</tbody>
</table>
2 Methods of Cellular Respiration

1. **Aerobic Respiration**: Hybrid Vehicle
   - Uses **Oxygen**
   - Most **efficient** method of "**using**" glucose
     - **40%** transferred into **ATP**
     - **60%** lost as **Heat** (waste)
   - 1 glucose = 36-38 ATP’s
   - Location: **Mitochondria**
2. **Anaerobic Respiration**: Hummer

- “NO Oxygen” is utilized
- **Inefficient** method of *using* Glucose

  ➞ **2%** transferred into **ATP**
  ➞ **38%** remain in **Lactic Acid or Ethanol**
  ➞ **60%** lost as **Heat** (waste)

1 glucose = 2 ATP’s

- Occurs w/in **Cytoplasm**
1. **ANAEROBIC: Without Oxygen**

- Glucose Breakdown *w/out* Oxygen
- Reaction:
  - Glucose: *6 Carbon Molecule*
    - a. Cut into *two 3 carbon molecules*
      - ✓ Animal cells: Lactic Acid
      - ✓ Unicellular organisms: Ethanol
    - b. *Two ATPs*
• Disadvantages:

1. **ONLY 2 ATP per glucose**
   - **Very Wasteful**

2. Results in lower tissue function
   - **Causes** muscle soreness & fatigue
   - **★ Increases muscle acid**
   - **Death to single cells**
   - **★ Ethanol**

% Alcohol Content:
Beer: ~3 – 4 %
Wince: ~13 %
• Advantage:
  ★ Can continue to produce **ATP** when oxygen is low

• Process also called **Fermentation**
2. **Aerobic Respiration**:  

- Multi-step process: Requires Oxygen  

dollars Three sets of Chemical reactions:

- a. Glycolysis  
- b. Krebs Cycle  
- c. Electron Transport Chain
Complete breakdown of GLUCOSE into:

a. Energy in glucose converted into: 36-38 ATP

b. Waste: Carbon Dioxide (CO₂)

c. Waste: Water molecules (H₂O)
• Oxygen’s Role in Aerobic Respiration

→ Oxygen used in last set of reactions

✓ Electron Transport Chain
✓ Electron transport chain produces **HIGH amounts of ATP**

a. Electrons are **removed from “food”**

b. Electrons are **passed** through the chain

c. Flow of electrons **power** the chain

d. Electrons removed from chain by **Oxygen**

\[ \text{O}_2 + \text{e}^- + \text{H}^+ \rightarrow \text{H}_2\text{O} \]
Electron Transport Chain
• **We breath in order to efficiently use nutrients for energy (ATP)**
Energy Demands: *Important points*

1. **Energy Storage:**
   
   - Energy *stored* in **ORGANIC MOLECULES**
   - *Carbohydrates (sugars), fats, protein*
2. **Energy Use:**

- ATP cannot be stored
- ATP must be made through continued *Cellular Respiration*

3. **ONLY Glucose can be used without Oxygen**

- **Anaerobic**
4. **FATS & PROTEINS** require OXYGEN

/awsmp/Aerobic !!!
Energy Content:

Fats: 9 Kcal / gram
Proteins: 4 Kcal / gram
Carbo’s: 4 Kcal / gram
Cellular Respiration