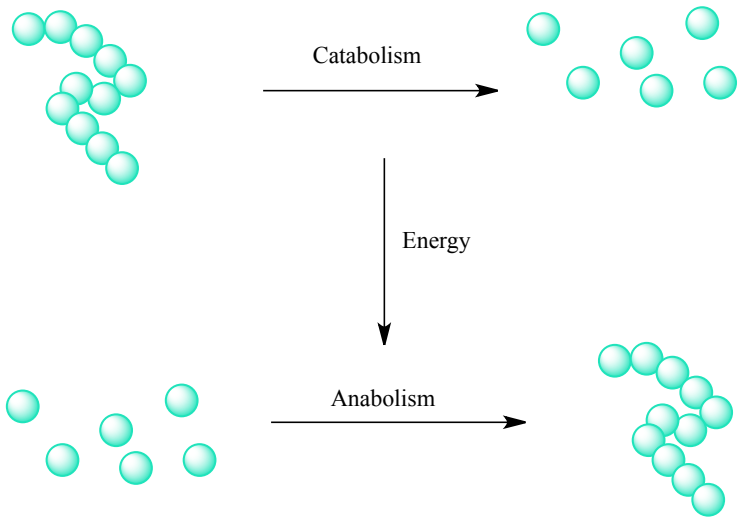
CONCEPT: BREAKDOWN AND UTILIZATION OF SUGAR

Metabolism Review

- **Metabolism** is the _____ of all chemical reactions in a cell
  - □ **Catabolism** includes all reactions that breakdown macromolecules
    - Energetically favorable, because energy is released from the bonds
  - □ **Anabolism** includes all reactions that synthesize and form macromolecules
    - Energetically unfavorable, because energy is needed to form the bonds
  - □ **Metabolic pathways** are series of reactions where the end product of one is the substrate for the next
    - *Metabolites* (*metabolic intermediates*) are compounds formed in the process of creating an end product

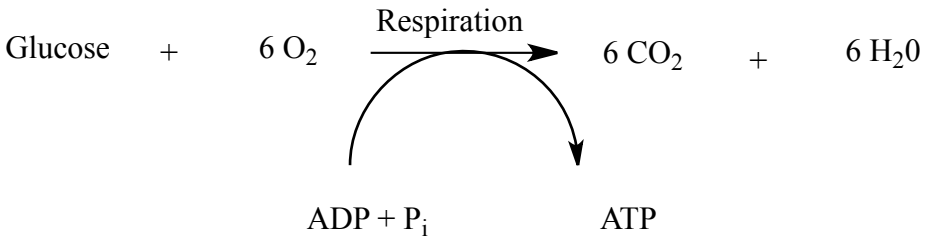
EXAMPLE: Catabolism vs. Anabolism



Importance of Glucose

- To survive, cells must get _____ from fuel molecules (ex: food)
  - □ **Cell respiration** is the process of harvesting useful energy from bonds in sugar molecules
    - The monosaccharide *glucose* is the most important sugar for respiration
      - ΔG = -686 kcal/mol
  - □ Breakdown of sugars (energetically favorable) is coupled with the creation of ATP (energetically unfavorable)
    - Process has to be controlled so the energy can be harvested by activated carriers

EXAMPLE: Cell respiration coupled to ATP synthesis



Stages of Catabolism

- Catabolism of food occurs in three stages

1. Digestion: Breakdown of larger molecules into small monomeric _____

   - Can occur outside cells (intestine) or inside cells (lysosomes)

2. Glycolysis: Breakdown of glucose or other sugar monomers into *pyruvate*

   - Occurs in the cytosol

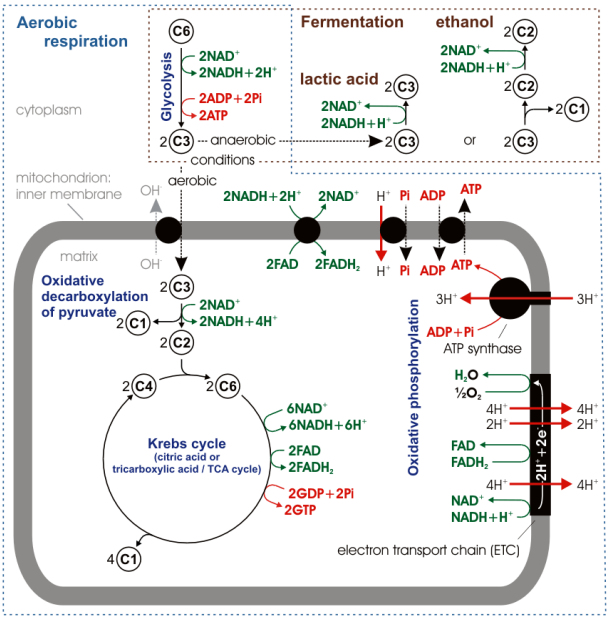
   - Generates ATP, NADH, and pyruvate is turned into CO_2 and acetyl CoA (an activated carrier)

3. **Oxidative phosphorylation**: Metabolic pathway that leads to the production of _____

   - Occurs in the mitochondria

   - Creates CO_2, NADH, ATP, and citrate (for the **citric acid cycle)**, while consuming O_2

EXAMPLE: Complexity of different metabolic pathways composing cellular respiration



Oxygen and Respiration

● The presence of _____ dictates which metabolic pathway the cell undertakes to breakdown fuel for energy

□ Two types of respiration are dependent on oxygen availability: *Anaerobic* (no oxygen) or *Aerobic* (with oxygen)

- Aerobic respiration has higher energy yields than anaerobic respiration

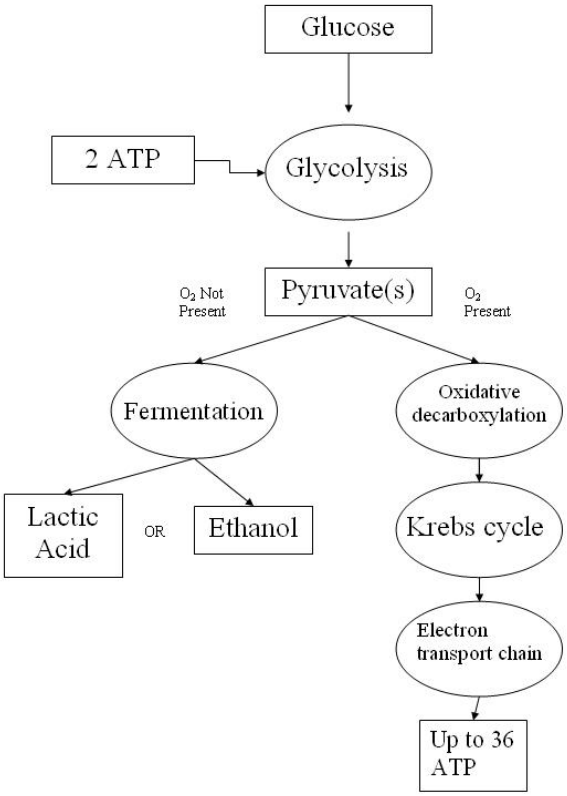
□ Organisms are named based on their requirement for oxygen during metabolism

- **Obligate aerobes**: Have an absolute requirement for oxygen (Humans)

- **Obligate anaerobes**: Cannot use oxygen, and oxygen can actually be toxic for them (some bacteria)

- **Facultative organisms**: Can function using either, and can switch between the two forms (some bacteria)

EXAMPLE: Choice of metabolic pathway is dependent on presence of Oxygen



PRACTICE

1. Which of the following definitions defines anabolism?
    a. All reactions that breakdown molecules
    b. All reactions that synthesize molecules
    c. A metabolic pathway that leads to the production of energy
    d. Process of harvesting useful energy from bonds in sugar molecules

2. Which of the following pathways causes the breakdown of glucose into pyruvate?
    a. Glycolysis
    b. Oxidative Phosphorylation
    c. Citric Acid Cycle
    d. Krebs Cycle

3. Oxygen is not required for metabolism in which type of organism?
    a. Obligate aerobes
    b. Obligate anaerobes
    c. Facultative organisms