

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

The diagram illustrates the process of photosynthesis within a chloroplast. Light energy enters the chloroplast and is captured by the thylakoids (stacks of green discs). Water ( $H_2O$ ) enters the light reactions, which produce oxygen ( $O_2$ ) and energy carriers (ATP and NADPH). Carbon dioxide ( $CO_2$ ) enters the Calvin cycle, which uses the energy from ATP and NADPH to produce sugar ( $CH_2O$ ).

**Figure 10.5**

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings.

Figure 10.12

- Consist of pigment molecules bound to particular proteins
- Funnel the energy of photons of light to the reaction center

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings.

The diagram illustrates the light reactions of photosynthesis in a chloroplast. It shows the flow of electrons from water-splitting enzymes through Photosystem II (PSII) and Photosystem I (PSI) to the Calvin cycle. Key components include the primary electron acceptors (P680 and P700), the electron transport chain (Pq, Cyt b<sub>6</sub>/f, Pc, Fd), and the final electron acceptor NADP<sup>+</sup>, which is reduced to NADPH. The resulting proton gradient drives ATP synthesis via ATP synthase. The Calvin cycle uses NADPH and ATP to fix CO<sub>2</sub> into sugar (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).

Figure 10.13

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

The diagram illustrates the light reactions of photosynthesis using a mechanical analogy. Two workers on tall scaffolds represent Photosystem II (left) and Photosystem I (right). A photon (represented by a yellow starburst) strikes Photosystem II, exciting an electron (e<sup>-</sup>) and causing it to jump to a higher energy level. This electron then travels through a series of carriers, represented by a worker passing a bucket (labeled 'e<sup>-</sup>') to another worker, who then passes it to a third worker. This process is coupled with the synthesis of ATP (represented by a yellow starburst labeled 'ATP' and the text 'Mill makes ATP'). The electron eventually reaches Photosystem I, where it is re-energized by another photon (represented by a yellow starburst). The re-energized electron then moves to a final carrier (represented by a worker passing a bucket labeled 'e<sup>-</sup>') and finally to NADPH (represented by a worker passing a bucket labeled 'NADPH'). The overall process is driven by the input of light energy (photons) and the resulting flow of electrons (e<sup>-</sup>) through the photosynthetic machinery.

Figure 10.14

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings.

### A different view: Animation

- This diagram is on your notes

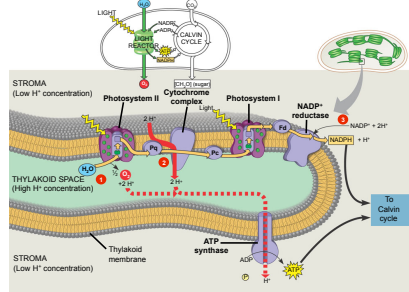


Figure 10.17

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

### Watch video 1<sup>st</sup> and then draw the cycle!

- The Calvin cycle

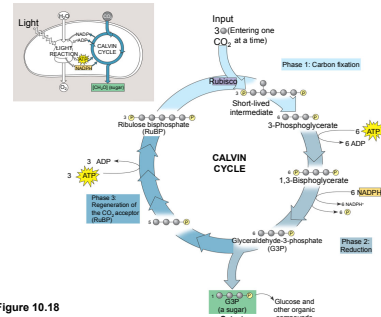


Figure 10.18

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

### The Importance of Photosynthesis: A Review

- A review of photosynthesis

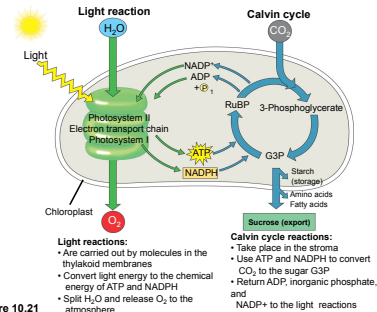


Figure 10.21

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## CELLULAR RESPIRATION

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

### Cellular respiration- Big idea

- Cellular Respiration allows **ALL** organisms to use (release) energy stored in the **chemical bonds of glucose**.
- The energy in glucose is used to produce ATP.
- Cells use ATP to supply their energy needs.
- To keep working
  - Cells must regenerate ATP

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

### Big Picture HANDOUT!

- There are three main processes in this metabolic enterprise

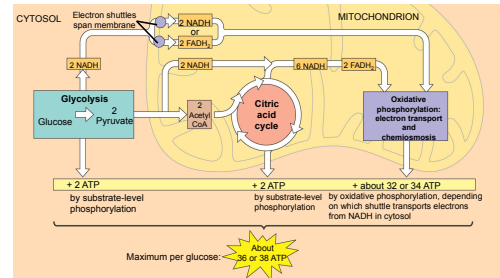


Figure 9.16

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## The Stages of Cellular Respiration: A Preview

Respiration is a cumulative function of three metabolic stages

1. Glycolysis
2. The Krebs cycle (citric acid cycle)
3. Oxidative phosphorylation (Electron Transport Chain)

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Big Picture

### 1. Glycolysis

- Breaks down glucose into two molecules of pyruvate

### 2. Krebs cycle (citric acid cycle)

- Completes the breakdown of glucose

### 3. Electron Transport & Oxidative phosphorylation

- Is driven by the electron transport chain
- Generates ATP

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## HANDOUT

### • An overview of cellular respiration

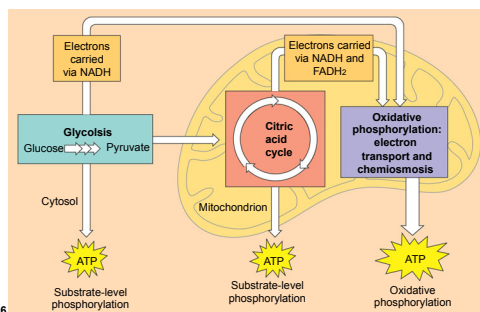


Figure 9.6

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

### • Both glycolysis and the citric acid cycle

- Can generate ATP by **substrate-level phosphorylation**

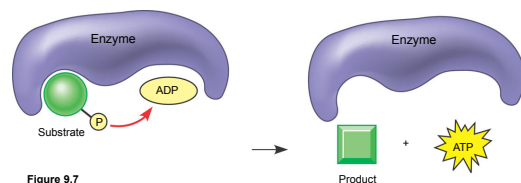


Figure 9.7

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Big Picture!

### • There are three main processes in this metabolic enterprise

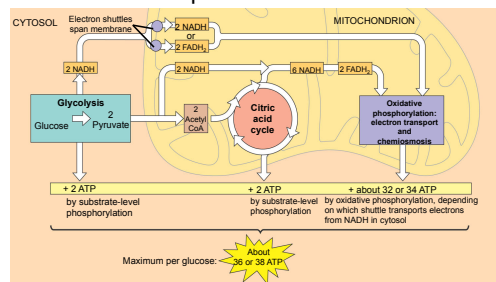
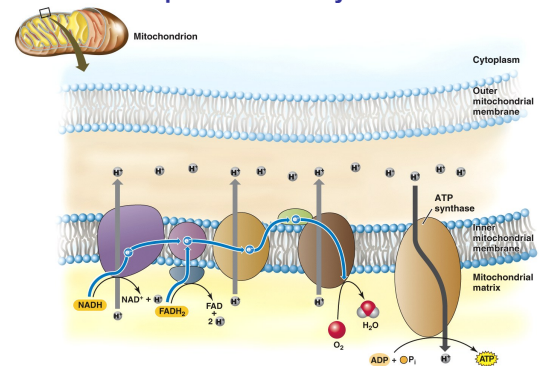


Figure 9.16

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Electron Transport and ATP Synthesis in



PRINCIPLES OF LIFE, Figure 6.12  
© 2012 Sinauer Associates, Inc.

## Chemiosmosis: The Energy-Coupling Mechanism

- **ATP synthase: Big Picture**
  - Is the **enzyme** that actually makes ATP

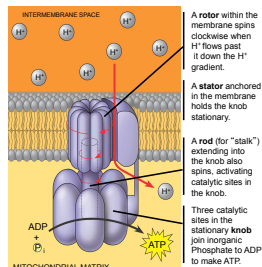


Figure 9.14

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Big Picture

- The resulting  $H^+$  gradient
  - Stores energy
  - Drives chemiosmosis in ATP synthase

(chemiosmosis = energy coupling mechanism that uses energy stored in the form of a  $H^+$  ion gradient across a membrane to drive cellular work, such as synthesis of ATP)

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Big Picture!

- There are three main processes in this metabolic enterprise

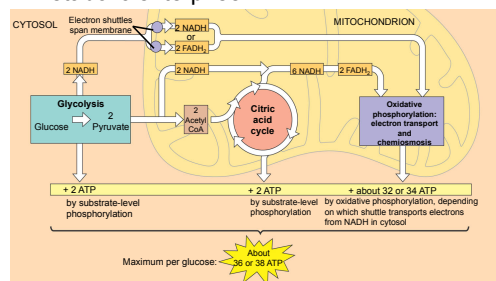


Figure 9.16

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

- About 40% of the energy in a glucose molecule
  - Is transferred to ATP during cellular respiration, making approximately 36 ATP

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Fermentation

- **NO OXYGEN?:** Fermentation enables some cells to produce ATP without the use of oxygen
- Cellular respiration
  - Relies on oxygen to produce ATP
- In the **absence of oxygen**
  - Cells can still produce ATP through **fermentation**

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

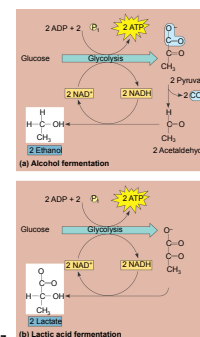


Figure 9.17

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## Big Picture

- Pyruvate is key!

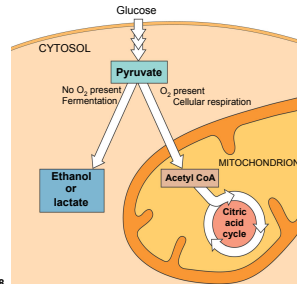


Figure 9.18

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## The Evolutionary Significance of Glycolysis

- Glycolysis
  - Occurs in nearly all organisms
  - Probably evolved in ancient prokaryotes before there was oxygen in the atmosphere

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

- The catabolism of various molecules from food

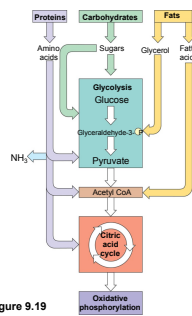


Figure 9.19

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

## HOMEOSTASIS

Copyright © 2005 Pearson Education, Inc. publishing as Benjamin Cummings

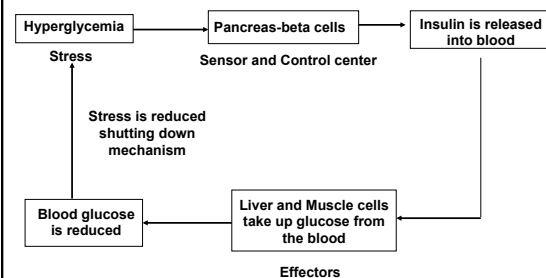
## Homeostasis

A condition in which the internal environment of the body remains relatively constant despite changes in the external environment.

Examples, in humans, would be.....?

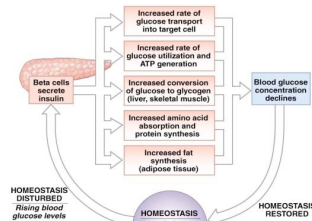
- 1) maintenance of body temperature
- 2) levels of glucose in the blood
- 3) Blood pH
- 4) O<sub>2</sub> and CO<sub>2</sub> levels
- 5) Blood pressure

## Homeostatic Regulation of Blood Sugar through Negative Feedback



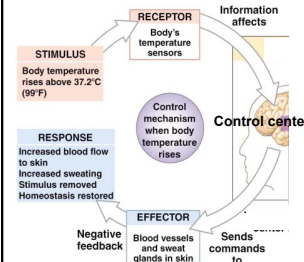
### Negative Feedback Via a Hormonal Pathway Regulation of Blood Sugar

Hormones play an important role in many homeostatic pathways. Hormones are produced by endocrine glands. They enter the blood after being produced and travel throughout the body. However, hormones have their effect on specific target tissues.



### Homeostasis Using a Neural Pathway

Many homeostatic mechanisms use a nerve pathway in which to produce their effects. These pathways involve an afferent path which brings sensory messages into the brain (often the hypothalamus) and an efferent path which carries outgoing nerve messages to effectors.

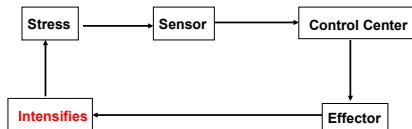


### Positive Feedback Mechanisms- Mrs. Wayman covers

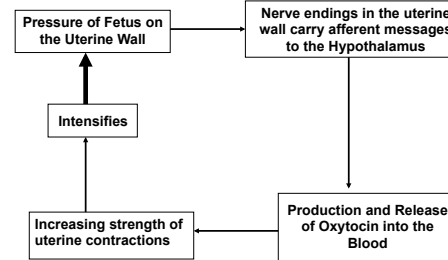
Homeostatic systems utilizing positive feedback exhibit two primary characteristics:

- 1. Time limitation** – Processes in the body that must be completed within a constrained time frame are usually modified by positive feedback.
- 2. Intensification of stress** – During a positive feedback process, the initial imbalance or stress is intensified rather than reduced as it is in negative feedback.

#### Typical Positive Feedback Process

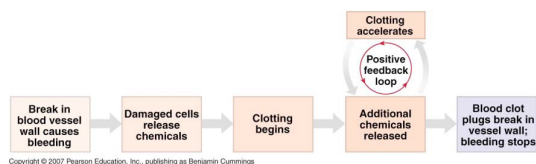


### Homeostatic Regulation of Child Birth through Positive Feedback



The birth of the child will bring this process to a close. Other examples of positive feedback regulation occur during milk letdown and blood clotting.

### Feedback in Coagulation



Positive feedback "mini-loops" are built into pathway to speed up production of chemicals needed to form the clot. Entire sequence of clotting is a negative feedback pathway:

### Homeostatic Regulation of Body Temperature through Negative Feedback

