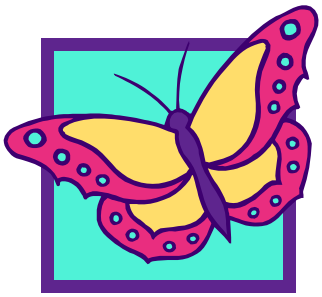
CHAPTER 6
METABOLISM, ENERGY AND LIFE



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FORMS OF ENERGY

- POTENTIAL IS STORED
- KINETIC IS IN MOTION
- LIGHT, CHEMICAL. HEAT, RADIATION, MECHANICAL, SOUND, LASER.
- LAW OF CONSERVATION OF ENERGY = ENERGY IS NOT CREATED OR DESTROYED, JUST TRANSFORMED.

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Figure 6.2x2 Kinetic and potential energy: cheetah at rest and running

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MAJOR ENERGY LAWS

- ENERGY IS TRANSFORMED TO OTHER FORMS= 1ST LAW OF THERMODYNAMICS.
- ENERGY MOVES FROM ORGANIZED TO RANDOM STATE = 2ND LAW OF THERMODYNAMICS.
- MEASUREMENT OF ENERGY IS ENTROPY
- + ENTROPY= TOWARD RANDOMNESS OF MATTER.
- - ENTROPY = TOWARD

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Figure 6.5 The relationship of free energy to stability, work capacity, and spontaneous change

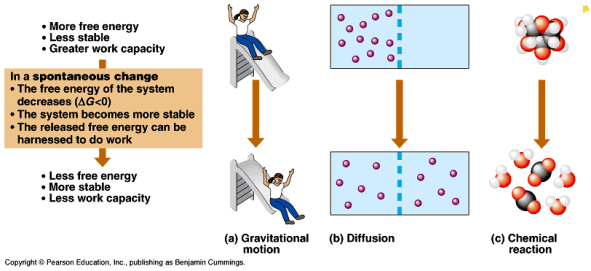

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Figure 6.6 Energy changes in exergonic and endergonic reactions

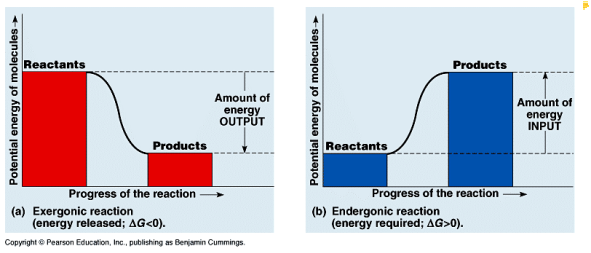

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Figure 6.7 Disequilibrium and work in closed and open systems

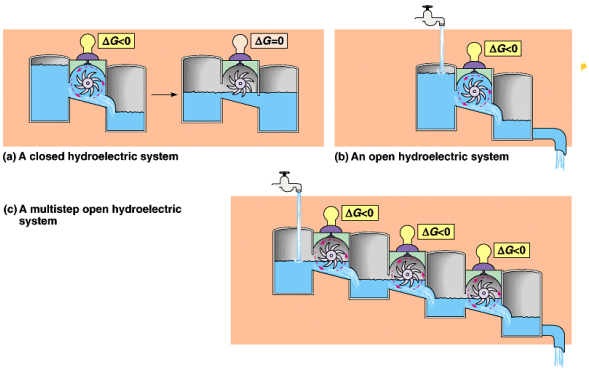


Figure 6.8 The structure and hydrolysis of ATP

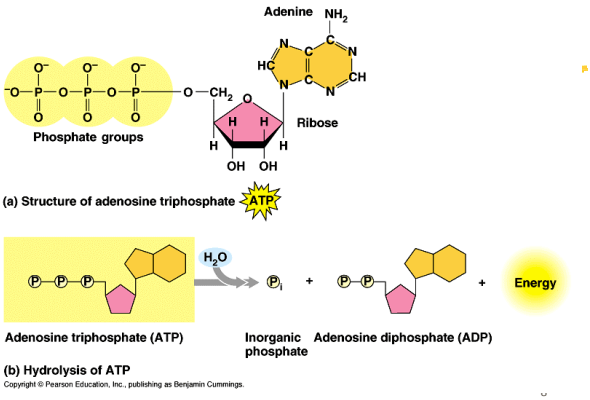
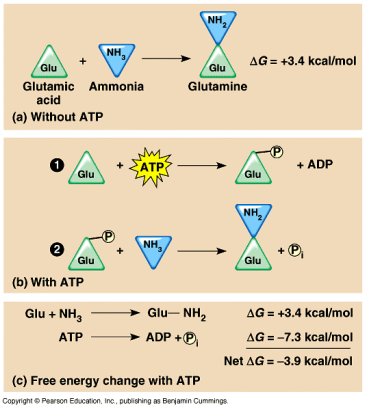


Figure 6.9 Energy coupling by phosphate transfer



ENZYME STRUCTURE

- ENZYMES ARE PROTEINS
- MADE FROM AMINO ACIDS (20)
- MADE DURING TRANSCRIPTION AND TRANSLATION
- HOOKED TOGETHER WITH PEPTIDE BONDS
- ENZYMES ARE LARGE MOLECULES
- WE INHERIT ENZYMES THRU GENES

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Figure 6.11 Example of an enzyme-catalyzed reaction: Hydrolysis of sucrose

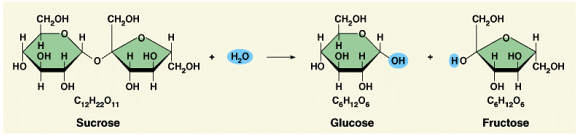

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Figure 6.14 The induced fit between an enzyme and its substrate

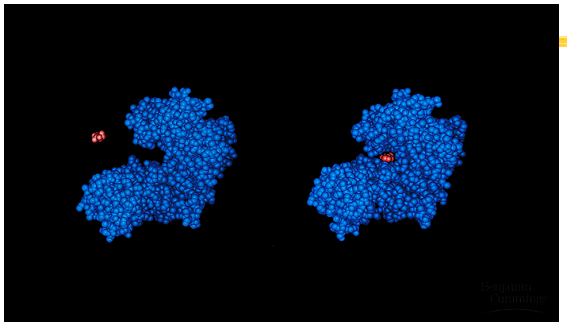

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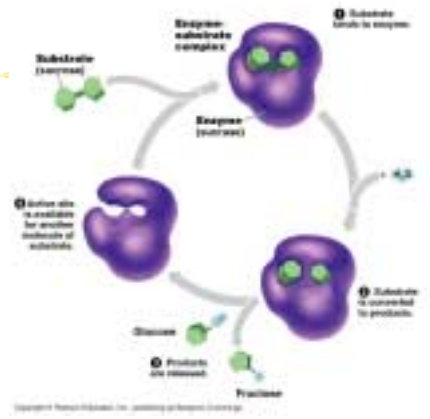
Figure 6.15 The catalytic cycle of an enzyme



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WHAT DO ENZYMES DO?

- ENZYMES ARE CATLYSTS
- THEY ARE BIOLOGICAL CATLYSTS
- THEY SPEED UP CHEMICAL REACTIONS AND THEN CAN BE REUSED.
- THEY LOWER THE ACTIVATION ENERGY OF A BIOLOGICAL REACTION
- ALLOW METABOLISM TO BE MORE EFFICIENT

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Figure 6.12 Energy profile of an exergonic reaction

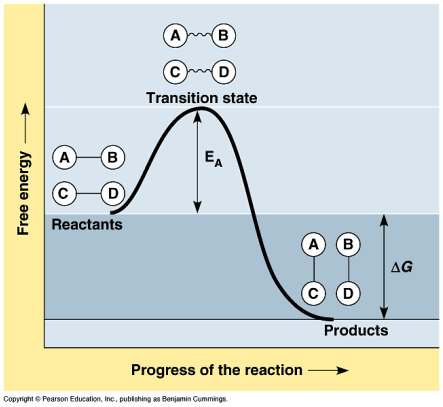

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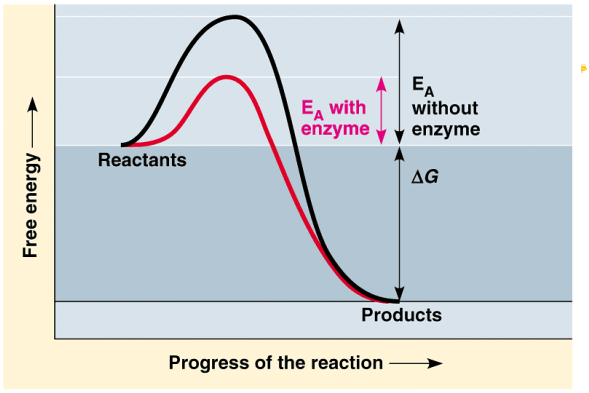
Figure 6.13 Enzymes lower the barrier of activation energy



ENZYME REACTIONS

- ENZYMES HAVE ACTIVE SITES
- ACTIVE SITES ATTACH TO THE SUBSTRATE
- THEN AN ENZYME-SUBSTRATE COMPLEX IS FORMED
- THE PRODUCTS ARE RELEASED AND THE ENZYME CAN BE REUSED
- ENZYME + SUBSTRATE = ES = PRODUCT

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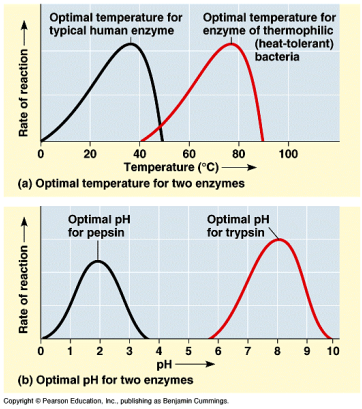
Figure 6.16 Environmental factors affecting enzyme activity



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MORE ENZYME REACTIONS

- MALTOSE + MALTASE = ES COMPLEX =
- GLUCOSE + GLUCOSE
- ENZYMES CAN HAVE COMPETITIVE INHIBITORS AT THE ACTIVE SITE
- ENZYMES CAN HAVE NON-COMPETETIVE INHIBITORS AT ANOTHER SIE
- INHIBITORS PREVENT THE ES FROM HAPPENING

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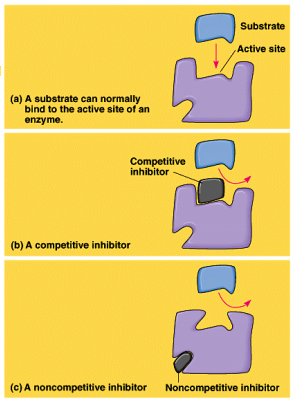
Figure 6.17 Inhibition of enzyme activity



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ENERGY AND ENZYMES

- METABOLISM: A FUNCTION OF CELL THAT ACQUIRE AND USE ENERGY
- ANABOLISM: BUILD OR SYNTHESIZE
- AA + AA - WATER = PROTEIN + ENERGY
- A DEHYDRATION SYNTHESIS REACTION
- CATABOLISM: DEGRADES, LYSES
- PROTEIN + WATER = AA + AA USES ENERGY

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ENERGY AND CHEMICAL REACTIONS

- EXERGONIC REACTIONS = ENERGY OUT
- . NET LOSS, CATABOLISM/RELEASE ENERGY
- REACTANT (AB) = PRODUCTS (A + B)
- ENDERGONIC REACTIONS = ENERGY IN
- . NET GAIN, ANABOLISM
- PRODUCTS (C + D) = CD; ABSORBS FREE ENERGY

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ENZYMATIC REACTIONS

- IN A SERIES OF METABOLIC REACTIONS, ENZYMES ARE NECESSARY AT EACH STEP TO MAKE THE COMPLETE REACTION
- LACTASE + LACTOSE + 3 ENZYMES = GLUCOSE AND GALACTOSE
- LACTOSE INTOLERANCE WITH NO ENZYMES
- MUST INHERIT ALL 3 ENZYMES THRU DNA TRANSCRIPTION AND TRANSLATION

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ENZYME ENVIRONMENT

- TEMPERATURES EFFECT ENZYMES; 55 DEGREES C DENATURES ENZYMES; TEMP. RANGE
- pH has an effect on enzymes (6.8-8.2)
- CONCENTRATION CAN EFFECT ENZYMES
- COFACTORS ARE MINERALS THAT HELP IN FORMING THE ENZYME/SUBSTRATE COMPLEX
- COENZYMES ARE ORGANIC MOLECULES

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ALLOSTERIC CONTROL

- METABOLIC POISONS/CONTROL ENZYME ACTION
- ALLOSTERIC SITE IS THE SPECIFIC BINDING SITE OF AN ENZYME TO A SUBSTRATE BUT REMOTE FROM THE ACTIVE SITE
- ALLOSTERIC REGULATION, INHIBITORS AND ACTIVATORS
- MEGA PROTEINS HAVE ALLOSTERIC CONTROL

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Figure 6.18 Allosteric regulation of enzyme activity

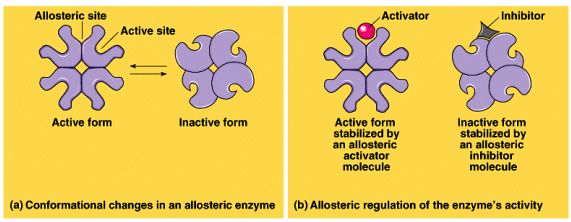

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Figure 6.19 Feedback inhibition

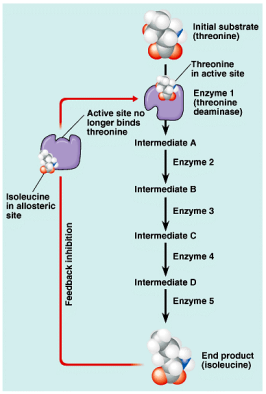

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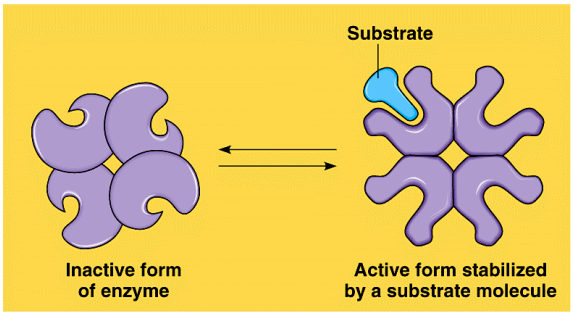
Figure 6.20 Cooperativity



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