Chapter 6: Metabolism Overview and Enzymes

1. Energy
   1. Cells Transform \_\_\_\_\_ as they Perform Work.
      1. Cells are miniature chemical factories, housing thousands of \_\_\_\_\_.
      2. Some of these chemical reactions \_\_\_\_\_ energy, and others \_\_\_\_\_ energy.
   2. Energy is the ability to do \_\_\_\_\_ or to cause change
   3. Two General Types of energy that exist in all forms of energy.
      1. \_\_\_\_\_ Energy: energy of \_\_\_\_\_
         1. Energy of \_\_\_\_\_ or \_\_\_\_\_ Energy
         2. \_\_\_\_\_ being done
         3. Some types
            1. Thermal energy: a type of kinetic energy associated with \_\_\_\_\_ and deals with the random \_\_\_\_\_ of atoms or molecules.

Heat flows (transfers \_\_\_\_\_ energy) from \_\_\_\_\_ to \_\_\_\_\_ (thus KE).

* + - * 1. \_\_\_\_\_ (Light) energy

kinetic energy of \_\_\_\_\_ or waves of light

Light energy is absorbed by \_\_\_\_\_.

* + 1. \_\_\_\_\_ Energy: \_\_\_\_\_ energy that matter possesses as a result of its location or structure.
       1. Stored Energy in:
* \_\_\_\_\_ bonds
* \_\_\_\_\_ gradients
* Electric potential (cell \_\_\_\_\_)
  + - 1. \_\_\_\_\_ Energy:
         1. The potential energy available for release in a chemical \_\_\_\_\_.
         2. The most important type of energy for living organisms to \_\_\_\_\_ the \_\_\_\_\_ of the cell.
  1. Energy can be \_\_\_\_\_ from one form to another.
  2. Cells \_\_\_\_\_ energy as the perform work.
     1. \_\_\_\_\_ is the study of energy \_\_\_\_\_ that occur in and between living organisms.
        1. The word \_\_\_\_\_ is used for the matter under study.
        2. The word \_\_\_\_\_ is used for everything outside the system; the rest of the universe.
        3. The two laws of thermodynamics that govern energy \_\_\_\_\_ in organisms.
           1. First Law of Thermodynamics

The law of Energy \_\_\_\_\_

Energy can be \_\_\_\_\_ and transformed

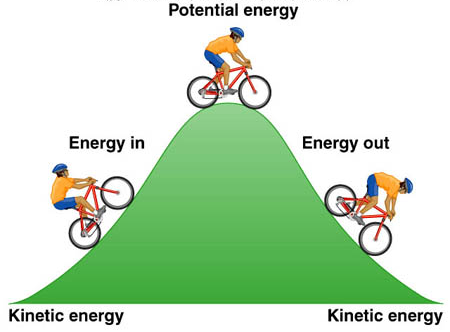
Energy \_\_\_\_\_ be created or destroyed.

* + - * 1. The Second Law of Thermodynamics

Energy conversions increase the \_\_\_\_\_ of the universe.

\_\_\_\_\_: measure of \_\_\_\_\_

II. Types of Chemical Reactions: E\_\_\_\_\_ & E\_\_\_\_\_

* 1. \_\_\_\_\_ Reactions
     1. Chemical reactions that \_\_\_\_\_ energy in the form of \_\_\_\_\_ to the surroundings.
     2. Release the energy stored in the covalent bonds of the \_\_\_\_\_.
     3. Burning wood \_\_\_\_\_ the energy in glucose as \_\_\_\_\_ and \_\_\_\_\_.
     4. Cellular \_\_\_\_\_
        1. Involves many steps
        2. \_\_\_\_\_ energy slowly
        3. Uses some of the released energy to produce \_\_\_\_\_
        4. \_\_\_\_\_ + 6O2 🡪 6 CO2 + 6H2O + \_\_\_\_\_
  2. \_\_\_\_\_ Reactions
     1. \_\_\_\_\_ energy from the surroundings
     2. Yield products rich in potential energy.
     3. Start with reactant molecules that contain relatively little \_\_\_\_\_.
     4. End with products that contain more \_\_\_\_\_.
     5. Photosynthesis
        1. Uses energy-\_\_\_\_\_ reactants (carbon dioxide and water).
        2. Energy is \_\_\_\_\_ from sunlight
        3. Energy-rich \_\_\_\_\_ molecules are produced.
        4. 6CO2 + 6H20 🡪 C6H12O6 + 6O2
        5. Plants, \_\_\_\_\_, \_\_\_\_\_ have photosynthesis and are called \_\_\_\_\_ because they can make their own food.
  3. Chemical Reactions
     1. A living organism carries out thousands of \_\_\_\_\_ and \_\_\_\_\_ chemical reactions
     2. The total of an organism’s chemical reactions is called \_\_\_\_\_.
     3. A metabolic pathway is a series of chemical reactions that either
        1. \_\_\_\_\_ a complex molecule or
        2. \_\_\_\_\_ \_\_\_\_\_ a complex molecule into simpler compounds.
     4. Energy is \_\_\_\_\_ - Energy Coupling
        1. Uses the energy released from \_\_\_\_\_ reactions to drive \_\_\_\_\_ reactions, typically using the energy stored in \_\_\_\_\_ molecules.
           1. \_\_\_\_\_ (Adenosine TriPhosphate) powers nearly all forms of cellular work.
           2. ATP consists of

Adenosine (a \_\_\_\_\_, adenine & a \_\_\_\_\_, ribose)

Triphosphate tail of three phosphate groups.

* + - 1. \_\_\_\_\_ of ATP releases energy by transferring its third phosphate from ATP to some other molecule in a process called \_\_\_\_\_.
      2. Most cellular work depends on \_\_\_\_\_ energizing molecules by phosphorylating them.
      3. \_\_\_\_\_ has enough stored energy to power a variety of cellular activities such as:
         1. \_\_\_\_\_ Protein synthesis
         2. Muscle contractions
         3. \_\_\_\_\_ transport across the cell membrane.
         4. \_\_\_\_\_ & repair
         5. Reproduction
      4. The \_\_\_\_\_ molecule is the basic \_\_\_\_\_ source of all living cells.
      5. In a cell, \_\_\_\_\_ is used continuously and must be regenerated continuously. In a working muscle cell, 10 million ATP are consumed and regenerated per second.
      6. A \_\_\_\_\_ uses & regenerates ATP continuously
      7. In the ATP Cycle, energy released in an \_\_\_\_\_ reaction, such as the breakdown of \_\_\_\_\_ during cellular respiration, is used in an endergonic reaction to \_\_\_\_\_ ATP from ADP.

Which pathway shows the hydrolysis of ATP ?

[ ] ATP + P + energy 🡪 ADP

[ ] ATP 🡪 ADP + P + energy

[ ] ADP 🡪 ATP + P + energy

[ ] ADP + P + energy 🡪 ADP

Label each item exergonic or endergonic.

1. Cellular Respiration
2. Phosphorylation of ATP
3. Photosynthesis
4. Hydrolysis of ATP

Label each item Potential Energy (PE) or Kinetic Energy (KE).

1. Chemical Bonds
2. Radiant Energy shining
3. Heat flowing
4. Concentration gradients
5. The Importance of \_\_\_\_\_ and how they Function
   1. Enzymes \_\_\_\_\_ \_\_\_\_\_ the cell’s chemical reactions by \_\_\_\_\_ energy barriers

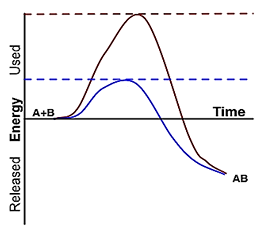
Time

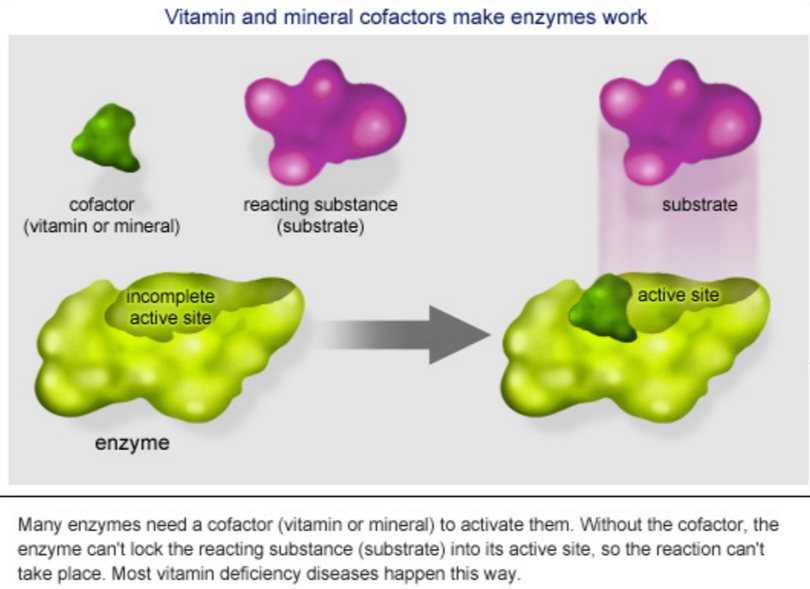
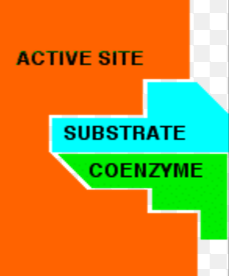
Energy

Activation energy

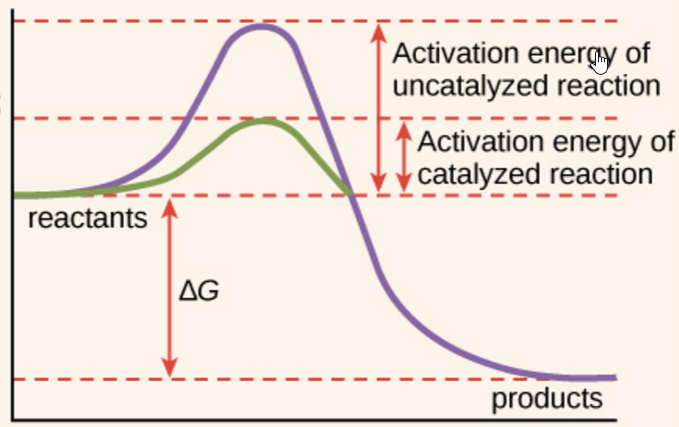
Reactants

Products

* + 1. Although biological molecules possess much \_\_\_\_\_, it is not released spontaneously.
       1. An energy \_\_\_\_\_ must be overcome before a chemical reaction can begin.
       2. This energy is called the \_\_\_\_\_ energy because it activates the reactants.
       3. Activation energy is the energy needed for a reactant molecule to move \_\_\_\_\_ to a higher-energy (although an unstable state) so the “\_\_\_\_\_” part of the reaction can begin.
       4. One way to speed up a reaction is to add \_\_\_\_\_, which agitates atoms so that bonds break more easily and reactions can proceed, but too much heat will kill a cell.
    2. Enzymes
       1. Function as biological \_\_\_\_\_.
          1. \_\_\_\_\_ up a reaction without being consumed by the reaction.
          2. They are usually \_\_\_\_\_.
          3. Are usually \_\_\_\_\_.
          4. Enzymes \_\_\_\_\_ \_\_ a reaction by lowering the activation energy needed for a reaction to begin.
       2. An enzyme is very \_\_\_\_\_ in the reaction it catalyzes.
       3. It has a \_\_\_\_\_ that determines the enzyme’s specificity
       4. The specific reactant that an enzyme acts on is called the enzyme’s \_\_\_\_\_.
       5. A substrate fits into a region of the enzyme called the \_\_\_\_\_ \_\_\_\_\_.
       6. Enzymes are specific because only \_\_\_\_\_ substrate molecules fit into their active site.
       7. For every enzyme, there are \_\_\_\_\_ conditions under which it is most effective.
       8. \_\_\_\_\_ affects molecular motion
          1. An enzyme’s \_\_\_\_\_ temperature produces the highest rate of contact between the reactants and the enzyme’s active site.
          2. Most human enzymes work best at 35-40**°**C.
       9. The optimal \_\_\_\_ for most enzymes is near neutrality (about 7).
    3. Enzyme Helpers
       1. \_\_\_\_\_ and \_\_\_\_\_
       2. Necessary for some \_\_\_\_\_ to function properly.
       3. Cofactors: inorganic (\_\_\_\_\_, \_\_\_\_\_, Zn+2, Fe+2, Ca+2) or organic.
       4. Coenzymes: organic; most \_\_\_\_\_, NAD, FAD.



Label the diagram by filling in the text boxes:



?

?

?

heat

?