

## A.P. Biology

Name \_\_\_\_\_

## Reading Sheet I – An Introduction To Metabolism

Campbell 142-149

Is the chemical activity that occurs in cells regulated? \_\_\_\_\_ (Yes / No)  
 The term “metabolism” refers to the \_\_\_\_\_ activity within a cell.



## Metabolism, Energy, and Life

To totality of an organism’s chemical reactions is called \_\_\_\_\_.  
 Is the environment within a cell *orderly* or *disorderly*? \_\_\_\_\_  
 Is the environment within your backpack *orderly* or *disorderly*? \_\_\_\_\_  
 Does polymer modification occur in a *single reaction* or through a *pathway*? \_\_\_\_\_  
 The reaction series that results in the degradation of a molecule is called a c \_\_\_\_\_ p \_\_\_\_\_.  
 The catabolic pathway of greatest importance is named c \_\_\_\_\_ r \_\_\_\_\_.  
 Complicated molecules are built through reaction series called a \_\_\_\_\_ p \_\_\_\_\_.  
 Most life reactions are c \_\_\_\_\_. That is to say, the energy released from one is used to “drive” the other.  
 The study of how organisms manage and balance their energy resources is called \_\_\_\_\_.

## Organisms Transform Energy

Energy – the capacity to perform \_\_\_\_\_.  
 Put another way, energy is the ability to rearrange \_\_\_\_\_.  
 The energy of motion is \_\_\_\_\_ energy.  
 Is light a form of *kinetic* energy or *potential* energy? \_\_\_\_\_  
 Is heat a form of *kinetic* energy or *potential* energy? \_\_\_\_\_  
 Energy that is “stored” or “waiting to happen” is called \_\_\_\_\_ energy.  
 Is water diffusing into a cell kinetic energy or potential energy? \_\_\_\_\_  
 Is the energy stored in a covalent bond *kinetic* energy or *potential* energy? \_\_\_\_\_  
 Is the energy in the food that you eat *kinetic* energy or *potential* energy? \_\_\_\_\_  
 Can all living things convert bond energy to kinetic energy? \_\_\_\_\_ (Yes / No)

**The Two Laws of Thermodynamics**

The study of energy transformations that occur in a collection of matter is called \_\_\_\_\_.  
 Are you an *open* system or a *closed* system? \_\_\_\_\_ Where does your energy come from?  
 Do the two Laws of Thermodynamics govern you? \_\_\_\_\_ (Yes / No)  
 In our universe, can energy be created or destroyed? \_\_\_\_\_ (Yes / No)  
 In your body, can energy be created or destroyed? \_\_\_\_\_ (Yes / No)  
 Can living things function as closed systems and recycle energy? \_\_\_\_\_ (Yes / No)  
 Please state the First Law of Thermodynamics in the space below:

Matter has a natural tendency to assume a state of \_\_\_\_\_ (Order / Disorder).

This tendency is titled e \_\_\_\_\_.

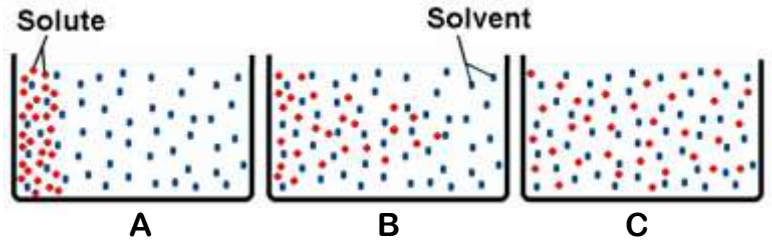
Please state the Second Law of Thermodynamics in the space below:

Do cells have the ability to decrease entropy? \_\_\_\_\_ (Yes / No)  
 In most energy transformations, at least part of the energy changes to \_\_\_\_\_.  
 A car is about \_\_\_\_\_ % efficient in its ability to transform energy into work.  
 The fate of all energy in living systems is its eventual conversion to \_\_\_\_\_.  
 The energy of \_\_\_\_\_ is energy in its most random state.  
 The lowest grade of energy is \_\_\_\_\_.  
 Can living things convert heat energy to potential energy? \_\_\_\_\_ (Yes / No)  
 In the biosphere, energy enters in the form of \_\_\_\_\_ and leaves in the form of \_\_\_\_\_.

**Free Energy**

Define “free energy” in the space below:

Which system (right) is richer in *free energy*?  
 \_\_\_\_\_ (A / B / C)



Does heat *increase* or *disrupt* order? \_\_\_\_\_



Which side of this equation has more free energy, **A** or **B**? \_\_\_\_\_

Graph an exergonic reaction

Free Energy and Metabolism -

**Exergonic Reaction (EX)**

**Endergonic Reaction (EN)**

- |  | + / - $\Delta G$ |
|--|------------------|
| _____ Net release of free energy.                | _____            |
| _____ Absorbs free energy from its surroundings. | _____            |
| _____ Catabolic reactions in living systems.     | _____            |
| _____ Much more likely to occur spontaneously.   | _____            |
| _____ “Uphill”                                   | _____            |
| _____ Cellular respiration                       | _____            |
| _____ Photosynthesis                             | _____            |

Graph an endergonic reaction

$$\Delta G = G(\text{final state}) - G(\text{initial state})$$

Why is “metabolic disequilibrium” necessary for life?

A.P. Biology  
Reading Sheet II – ATP

Name \_\_\_\_\_  
“0% Chance” Future Occupation \_\_\_\_\_

Campbell 149-151

List three categories of work accomplished by living cells:

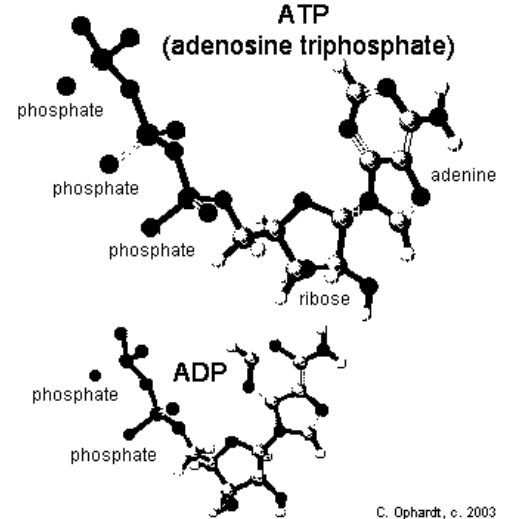
- 1.
- 2.
- 3.

Cellular work is powered by \_\_\_\_\_.

ATP is the abbreviation for \_\_\_\_\_.

The nitrogen-containing base of ATP is \_\_\_\_\_.

The sugar of ATP is named \_\_\_\_\_.



The hydrolysis of ATP (shown below) yields \_\_\_\_\_ kcal/mol of free energy.



In a *cell*, this figure is inflated to an actual \_\_\_\_\_ kcal/mol.

Are the phosphate-phosphate bonds in ATP relatively *strong* or relatively *weak*? \_\_\_\_\_

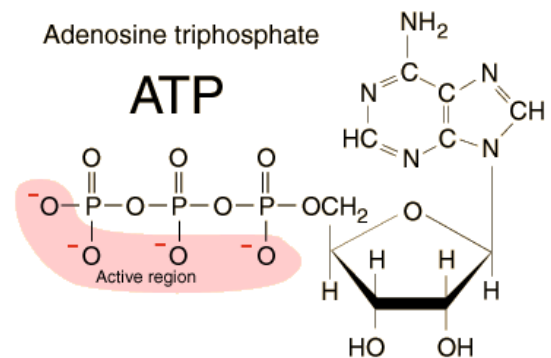
When ATP is hydrolyzed in a non-living system, all of the energy is liberated in the form of \_\_\_\_\_.

***What happens in a living cell to prevent this potential loss of energy? (Important idea!!)***

Little known facts:

- The total human body content of ATP is only about 50 grams.
- In each ATP molecule, the terminal phosphate is added and removed an average of 3 times each minute.

Account for ATP's instability (or willingness to give up its third phosphate) by making reference to the graphic formula below:



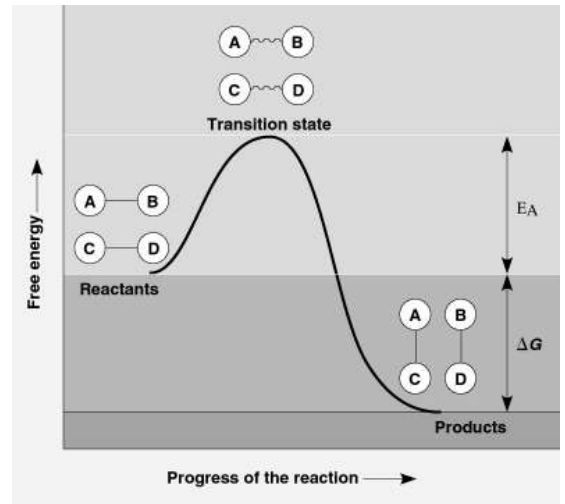
What fundamental cell process is responsible for providing most of the energy for ATP synthesis?

A.P. Biology  
 Reading Sheet III – Enzymes  
 Campbell 152-160

Name \_\_\_\_\_

Can (do) enzymes.....

- \_\_\_\_\_ demonstrate specificity?
- \_\_\_\_\_ be composed entirely of carbohydrates?
- \_\_\_\_\_ be activated?
- \_\_\_\_\_ be inhibited?
- \_\_\_\_\_ be recycled?
- \_\_\_\_\_ be digested?
- \_\_\_\_\_ catalyze synthesis reactions?
- \_\_\_\_\_ catalyze decomposition reactions?
- \_\_\_\_\_ require substantial heat to function?
- \_\_\_\_\_ change the free energy generated or used up during a reaction?
- \_\_\_\_\_ change shape at the conclusion of a reaction?
- \_\_\_\_\_ move on their own?



**Vocab. Fill-ins**

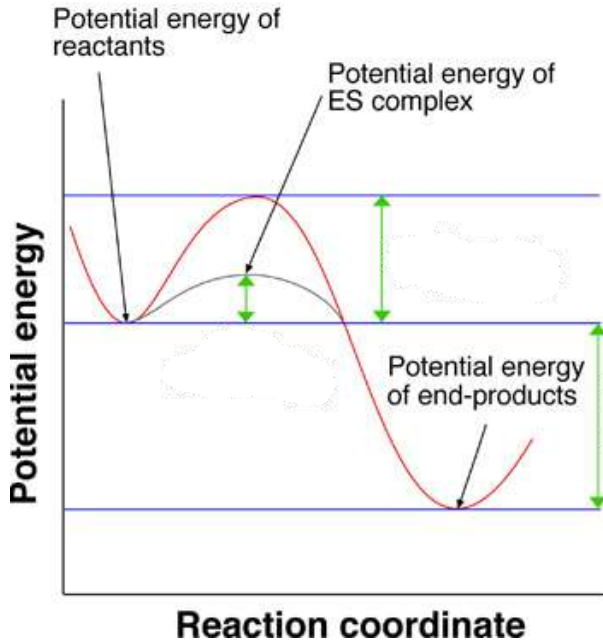
- \_\_\_\_\_ Any substance *acted upon by an enzyme* is its \_\_\_\_\_.
- \_\_\_\_\_ The hypothesis that states that the shape of an enzyme *changes slightly* as it begins reaction catalysis is the \_\_\_\_\_ hypothesis.
- \_\_\_\_\_ Any substance or physical factor that *increases the rate of a chemical reaction* is a(n) \_\_\_\_\_.
- \_\_\_\_\_ Enzymes lower the \_\_\_\_\_ energy needed to initiate a reaction.
- \_\_\_\_\_ The bonds of life are typically \_\_\_\_\_ (*ionic / covalent*) bonds.
- \_\_\_\_\_ Enzymes nearly always belong to the organic molecule category \_\_\_\_\_.
- \_\_\_\_\_ Enzymes are synthesized upon the *organelle* named the \_\_\_\_\_.
- \_\_\_\_\_ The union of enzyme and substrate is merely a matter of \_\_\_\_\_.
- \_\_\_\_\_ The enzyme and substrate join at the \_\_\_\_\_.
- \_\_\_\_\_ As substrate concentration increases, the probability of collision with its enzyme \_\_\_\_\_.
- \_\_\_\_\_ Do biochemical reactions occur in the *absence* of enzymes?
- \_\_\_\_\_ Agents which bind to and increase the efficiency or specificity of enzymes are called \_\_\_\_\_.
- \_\_\_\_\_ Are enzymes typically *globular* proteins or *fibrous* proteins?
- \_\_\_\_\_ Do bonds form within an enzyme-substrate complex? (*yes / no*)
- \_\_\_\_\_ When all active sites are occupied, \_\_\_\_\_ is reached.
- \_\_\_\_\_ Each step in a metabolic pathway is regulated by a specific \_\_\_\_\_.
- \_\_\_\_\_ When a protein is “denatured”, its \_\_\_\_\_ shape has been altered.
- \_\_\_\_\_ Do enzymes “only” function within cells? (*yes / no*)

Enzymes – Campbell

- \_\_\_\_\_ The *other* type of biological catalyst, made of RNA, is a \_\_\_\_\_.
- \_\_\_\_\_  $E_A$  is a succinct abbreviation for \_\_\_\_\_.
- \_\_\_\_\_ If a system is rich in energy (say....heat energy), is the system *stable* or *unstable*?
- \_\_\_\_\_ The “summit” of an exergonic reaction graph is called the \_\_\_\_\_ state.
- \_\_\_\_\_ Do most organic molecules decompose spontaneously? (*Yes / No*)
- \_\_\_\_\_ This is because their decomposition has a (*high / low*) activation energy.
- \_\_\_\_\_ Does “heat” speed up life reactions? (*Yes / No*)

\_\_\_\_\_ Organisms do not use heat to catalyze reactions because protein d\_\_\_\_\_ occurs.  
 \_\_\_\_\_ The net energy yield of a reaction is designated by calling it  $\Delta$  \_\_\_\_\_.  
 \_\_\_\_\_ Does  $\Delta G$  change when a life reaction is enzyme-catalyzed? (Yes / No)  
 \_\_\_\_\_ Does  $E_A$  change when a life reaction is enzyme-catalyzed? (Yes, It Rises/ Yes, It Falls / No)

On the graph below, label:  $E_A$  with enzyme,  $E_A$  without enzyme,  $\Delta G$ , Transition State



\_\_\_\_\_ Is the reaction above *exergonic* or *endergonic*?  
 \_\_\_\_\_ Can an enzyme distinguish between molecular isomers? (Yes / No)  
 \_\_\_\_\_ Is the active site on an enzyme usually a *pocket* or a *bulge*?  
 \_\_\_\_\_ Is an active site *rigid* or *flexible*?  
 \_\_\_\_\_ According to a dictionary or thesaurus, "induced" means \_\_\_\_\_.  
 \_\_\_\_\_ What bond types form between enzyme and substrate?  
 \_\_\_\_\_ A typical enzyme acts upon \_\_\_\_\_ (#) substrate molecules per second.  
 \_\_\_\_\_ Are enzymes *unidirectional* or *bidirectional* in their regulation of chemical reactions?  
 \_\_\_\_\_ Which way a reaction proceeds depends upon the \_\_\_\_\_ of reactants and products.  
 \_\_\_\_\_ The optimal temperature range for most human body enzymes is \_\_\_\_\_°C.  
 \_\_\_\_\_ The optimal pH range for most human body enzymes is \_\_\_\_\_°C.  
 \_\_\_\_\_ Non-protein "helpers" for enzymes are called \_\_\_\_\_.  
 \_\_\_\_\_ If a cofactor is an organic molecule, it is called a \_\_\_\_\_.  
 \_\_\_\_\_ Many v\_\_\_\_\_ are coenzymes.  
 \_\_\_\_\_ An enzyme inhibitor that attaches to the active site is called a c\_\_\_\_\_ i\_\_\_\_\_.  
 \_\_\_\_\_ Offsite inhibitors are called n\_\_\_\_\_ i\_\_\_\_\_.  
 \_\_\_\_\_ Most noncompetitive inhibitors cause an enzyme molecule to change s\_\_\_\_\_.

\_\_\_\_\_

Is this competitive or noncompetitive inhibition?



\_\_\_\_\_

Do cells have the ability to turn enzymes "on" and "off"? (Yes / No)

\_\_\_\_\_

Do cells purposefully inhibit enzymes? (Yes / No)

\_\_\_\_\_

An enzyme regulator attaches at an a\_\_\_\_\_s\_\_\_\_\_.



Draw an arrow to the allosteric site on the enzyme drawn to the left.

\_\_\_\_\_

What type of inhibition is occurring in the diagram to the right?

\_\_\_\_\_

Where in the cell are respiratory enzymes found?

\_\_\_\_\_

Where in a cell are protein-digesting enzymes found?

\_\_\_\_\_

Where in the cell are amino-acid binding enzymes found?

