ENERGY and METABOLISM

NOTE to STUDENTS and FACILITATORS: One of the main purposes of the Workshops is to allow free exchange of information by **having each member of a Learning Community in turn answer one part** of a discussion question. As each student explains a term or gives a definition in their own words, it should allow for free verbal EXCHANGE and promote learning by interaction. **Try to insure that everyone in your Learning Community does a question or two and the purpose of the exercise is that they must EXPLAIN THEIR ANSWERS to the rest of the community.**

IN THE GRAND SCHEME

Energy is a requirement of life. Cellular life is awfully hard work; energy must be expended to perform all the metabolism that keeps a cell going. Chemical reactions, cellular activities, running, reproducing, - all require energy. Without a steady source of replenishable energy cells would die. Photosynthetic organisms use sunlight as an energy source and convert solar energy into chemical bond energy (glucose). Heterotrophic organisms use the chemical bond energy to transform it into a more immediately useable form (ATP).

FOR REVIEW

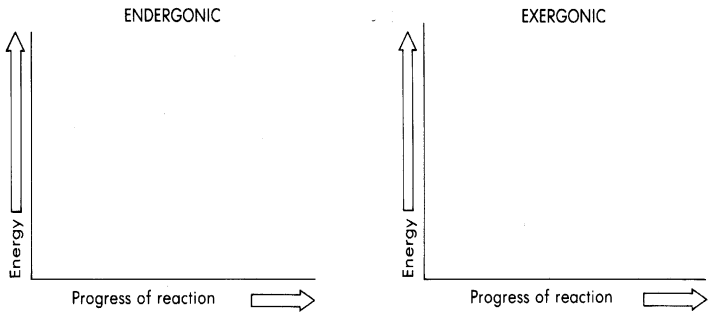
A. Have the first seven members of your Learning Community list seven (7) different forms of energy. These need not be related to or found in cells.

B. Have each member of your Learning Community, in turn, define a KEY TERM given below and tell how it may relate to the concepts of energy and metabolism. As a group, help each other answer any portion of the review section that any person does not understand before proceeding further.

a) Nature of Chemical Bond	e) Free energy	i) Catabolic vs. anabolic
b) Proton Pump	f) anaerobic metabolism	j) Phosphorylation
c) Entropy	g) Redox reaction	k) dehydrogenase enzymes
d) Potential vs. Kinetic Energy	h) Chemiosmosis	l) cytochrome

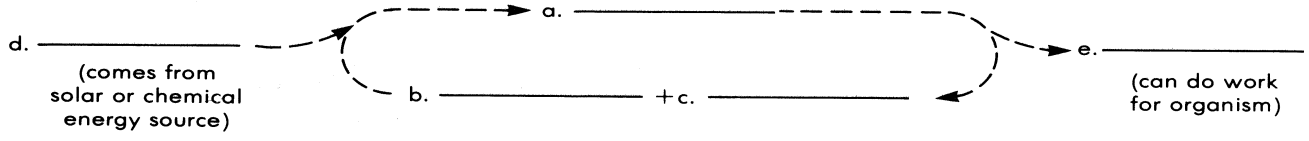
ENERGY GRAPHS

Have one member each go to a blackboard (or use a piece of paper) to complete the following graphs to illustrate an exergonic reaction and an endergonic reaction. Be sure to includes labels for the reactants, products, and activation energy. Indicate for each graph whether the products or the reactants contain more energy. Have the rest of your Learning Community critique whether or not the graphs are properly depicted.



ENERGY FLOW

Have five members of your learning community in turn identify the alphabetic labels in the figure below, which depicts how ATP, ADP, and P are cycled and recycled through living cells and how energy is involved in this cycling. The five terms to be identified are: ADP, ATP, P, Energy Added, and Energy released. Discuss the significance of this energy flow diagram.



CELL RESPIRATION.

Have one member each, in turn, complete the following chart. At each of the indicated stages of cell respiration identify which of the following 5 molecules are produced at that stage. (A substance may be used more than once)

STAGE	SUBSTANCE (products) PRODUCED
1. Glycolysis	?
2. Fermentation	?
3. Oxidation of Pyruvate	?
4. Citric Acid Cycle	?
5. Electron Transfer Chain	?

ELECTRON TRANSFER CHAIN - Paragraph Fill In.

One member each, in turn, from your Learning Community fill in one of the blanks given below in the paragraph which describes the events in the electron transfer chain.

Electron are taken from **A.**_____ and/or **B.**_____, which then convert to **C.**_____ & **D.**_____. These electrons are passed along the transport chain, a series of protein and carrier molecules (electron acceptors) such as **E.**_____. The final (terminal) electron acceptor is **F.**_____, which combines with electrons & **G.**_____ to form **H.**_____. As the electron travel through the transport chain, they provide sufficient loss in energy to drive **I.**_____ , which causes **J.**_____ to be produced by the process called **K.**_____.

GLYCOLYSIS

The reactions of ***glyco-lysis*** are often divided into two phases: a) an energy investment phase and b) an energy-yielding phase. Have two different members of your Learning Community describe to the rest of the Community what is meant by each one of these terms.

ELECTRON TRANSFER CHAIN

The electron transfers chain is made of a linked series of electron acceptor/donor molecules embedded into the inner cristae membranes of the mitochondria. Each successive electron carrier has a different electro-negativity than the one before it, so that electrons are pulled downhill to a terminal acceptor. Many of these carriers are proteins and are tightly coupled with their own PROSTHETIC groups (non-protein coenzymes). In the table below have one member each, in turn, fill in the missing prosthetic group.

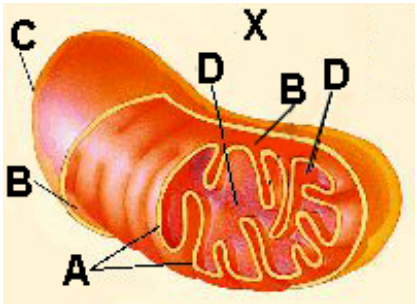
Electron Protein Carrier	**Prosthetic Group (coenzyme)**
cytochromes	
iron-sulfur proteins	
flavoproteins	
ubiquinone	

A DIFFERENT KIND OF CONCEPT MAP…

The metabolic pathways of cellular respiration and the oxidation of food stuffs are very detailed and complex. It is easy for one to lose sight of the important concepts for the magnitude of details that are present. One of the best ways to learn the main concepts of cellular respiration is to explain them to someone else. Have one member of your Learning Community, each in turn, explain the important concepts and steps of glycolysis, Krebs Cycle, and the electron transfer chain by filling in one of the the boxes in the table below. Then verbally explain the significance of that section of the table. You may use diagrams and sketches to help you explain the process, if desired. Make sure everyone complete understands each section of the table before going on to another section.

Process	Main Function (concept)	Inputs	Outputs
Glycolysis			
Pyruvate to Acetyl-CoA			
Krebs Cycle			
Electron Transfer chain & oxidative phosphorylation			
Fermentation			
Anaerobic Respiration (lactic acid production)			

SOME IDENTIFICATIONS OF WHERE…

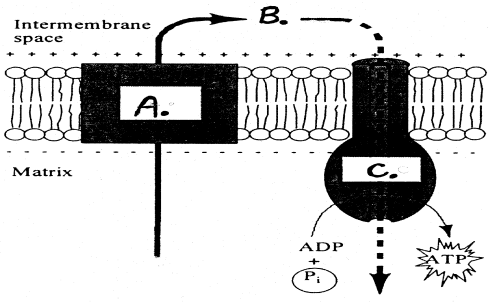


Questions 1 to 6 use the figure on the right....

1. Site of the higher H^+ concentration : _____; and why ?
2. Membrane that is more freely permeable : _____ ?
3. What is label C : _____ ?
4. What is label D : _____ ?
5. Where is the pH is likely lowest : _____ ?
6. The site where glycolysis occurs : _____ ?

Questions 7 to 10 use the figure on the left.

7. What is the molecule at label B _____ in figure to the left?
8. What is the name of the system identified by label A____?
9. What is label C_____?
10. What is the name given to the cellular process identified by the labels A., B., and C. ?



SOME THOUGHT QUESTIONS

The international wine industry is a multi-billion dollar industry. Wines are distinguished by color, flavor, bouquet (aroma), and alcoholic content. They may be red (when the whole crushed grape is used), white (using the juice only), or rosé (when skins are removed after fermentation has begun). Wines are also classified as dry (when grape sugar ferments completely) or sweet (when some sugar remains). There are three main types of wine: natural (still), fortified, and sparkling. Fortified wine (e.g., SHERRY, port, Madeira) has brandy or other spirits added to it. Sparkling wine (CHAMPAGNE is the best known) is fermented a second time after bottling.

a. Why is wine alcoholic?
b. What are the four chemical products made by the process of fermentation of grapes into wine?
c. A fortified wine is defined as one in which alcohol has been added to the naturally fermented wine. Naturally fermented wines do not contain an alcohol content greater than about 12% ethanol. Why?

cm - 2017