LECTURE 15 - RESPIRATION

QUESTIONS TO TRY FOR PRACTICE

Chapter 9 Cellular Respiration and Fermentation

1) A cell has enough available ATP to meet its needs for about 30 seconds. What is likely to happen when an athlete exhausts his or her ATP supply?
A) He or she has to sit down and rest.
B) Catabolic processes are activated that generate ATP.
C) ATP is transported into the cell from circulation.
D) Other cells take over and the muscle cell that has used up its ATP quits.

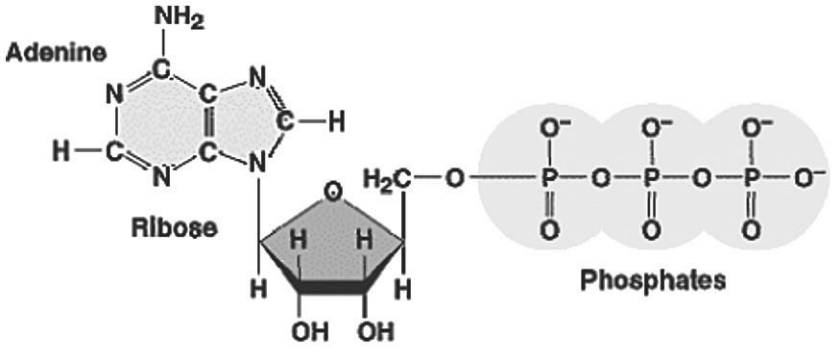


Figure 9.1

2) Refer to Figure 9.1. What characteristic of this molecule (ATP) is responsible for its high energy level compared to AMP?
A) the nitrogen atoms in adenine
B) the phosphorus atoms in the phosphate groups
C) the C—H bonds of the ribose sugar
D) the closely spaced negative charges associated with the phosphate groups

3) Which of the following is true of oxidation-reduction (redox) reactions?
A) They involve the transfer of one or more carbon atoms from one molecule to another.
B) They allow organisms to convert energy from large macromolecules for cellular use.
C) They allow organisms to convert energy from photons of light for cellular use.
D) B and C are true of redox reactions.
E) A, B, and C are true of redox reactions

4) The glucose molecule has a great deal of energy in its
A) C-H bonds.
B) C-N bonds.
C) number of oxygen atoms.
D) polar structure.

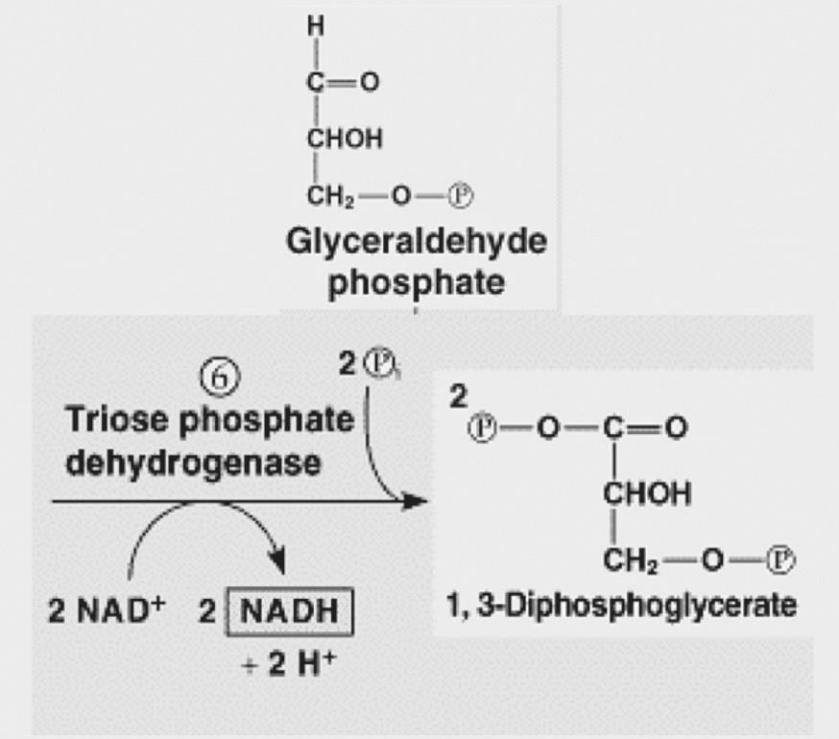


Figure 9.2

5) Refer to Figure 9.2. Which reactant molecule becomes reduced in the following chemical reaction?

Glyceraldehyde phosphate + NAD^+ → diphosphoglycerate + NADH + H^+

A) glyceraldehyde phosphate
B) the electrons
C) NAD^+
D) phosphate

6) Following glycolysis and the Krebs cycle and before the electron transport chain and oxidative phosphorylation, the carbon skeleton of glucose has been broken down to CO_2. Most of the energy from the original glucose at that point is still in the form of
A) ATP.
B) CO_2.
C) H_2O.
D) NADH.

7) Why might adding inorganic phosphate to a reaction mixture where glycolysis was rapidly proceeding help sustain the metabolic pathway?
A) It would increase the amount of glucose available for catabolism.
B) It would increase the oxygen supply available for aerobic respiration because each phosphate group has four oxygen atoms as constituents.
C) The metabolic intermediates of glycolysis are phosphorylated.
D) It increases the energy level of the electrons that are transferred to the electron transport chain where ATP is produced.

8) Two ATP molecules are expended in the energy investment phase of glycolysis. Why is this energy necessary to begin the process of glucose catabolism?
A) It isn't; glucose contains 686 kcal/mole in its chemical bonds, so its catabolism is spontaneous.
B) It is needed to generate the electron carrier NAD^+.
C) It is needed to prime the enzymes of glycolysis.
D) Glucose is a stable molecule; thus, some energy must be invested to make the molecule unstable and begin the process of catabolism.

9) In the energy-yielding phase of glycolysis, energy is extracted in the form of
A) pyruvate.
B) carbon dioxide.
C) NADH and ATP.
D) phosphorylated intermediates.

10) A metabolic pathway, glycolysis, is active when cellular energy levels are _____; the regulatory enzyme, phosphofructokinase, is _____ by ATP.
A) low; activated
B) low; inhibited
C) high; activated
D) high; inhibited

11) The enzyme phosphofructokinase is the major regulatory enzyme of glycolysis. It catalyzes
A) the first of the 10 reactions of glycolysis.
B) the isomerization of glucose 6-phosphate to fructose 6-phosphate.
C) the phosphorylation of fructose 6-phosphate.
D) the substrate-level phosphorylation reaction whereby phosphoenolpyruvate is converted to pyruvate.

12) Canine phosphofructokinase (PFK) deficiency afflicts springer spaniels, affecting an estimated 10% of the breed. PFK is the glycolytic enzyme that phosphorylates fructose-1-phosphate and catalyzes the committed step in glycolysis. Given its critical role in glycolysis, one implication of the genetic defect resulting in PFK deficiency in dogs is
A) early embryonic mortality.
B) elevated blood-glucose levels.
C) exercise intolerance.
D) nothing. It would have no visible effect on the health of the animal.

13) Substrate-level phosphorylation occurs within a metabolic pathway where sufficient energy is released by a given chemical reaction to drive the synthesis of ATP from ADP and phosphate. Substrate-level phosphorylation is seen in which metabolic pathway(s)?
A) glycolysis
B) Krebs cycle
C) both glycolysis and the Krebs cycle
D) electron transport chain
E) All of the above pathways involve steps where substrate level phosphorylation takes place.

14) What electron carrier(s) function in the Krebs cycle?
A) NAD^+ only
B) both NAD^+ and FAD
C) the electron transport chain
D) FAD only

15) When one of the eight Krebs cycle intermediates is added to the respiration medium of living cells, like yeast, what happens to the rates of ATP and carbon dioxide production?
A) There would be no change in ATP production but an increased rate of carbon dioxide production.
B) The rates of ATP production and carbon dioxide production both increase.
C) The rate of ATP production decreases, but the rate of carbon dioxide production increases.
D) Rates of ATP and carbon dioxide production both decrease.

16) What is the function of coenzyme A in the Krebs cycle?
A) It is the coenzyme of carboxylation reactions.
B) It is the coenzyme of redox reactions.
C) It is a coenzyme of dehydration reactions.
D) It is the coenzyme of acetylation reactions.

17) A substrate-level phosphorylation occurs in the Krebs cycle where
A) GDP is phosphorylated to produce GTP.
B) NAD^+ is phosphorylated to NADH.
C) oxaloacetate is phosphorylated.
D) acetylation of oxaloacetate takes place.

18) Which of the following statements concerning cellular metabolism is FALSE?
A) Glycolysis is inhibited when cellular energy levels are abundant.
B) Krebs cycle activity is dependent solely on availability of substrate; otherwise it is unregulated.
C) In the electron transport chain, electrons decrease in energy level as they are transferred from one electron carrier to the next.
D) Reactions of the Krebs cycle take place in the mitochondrial matrix.

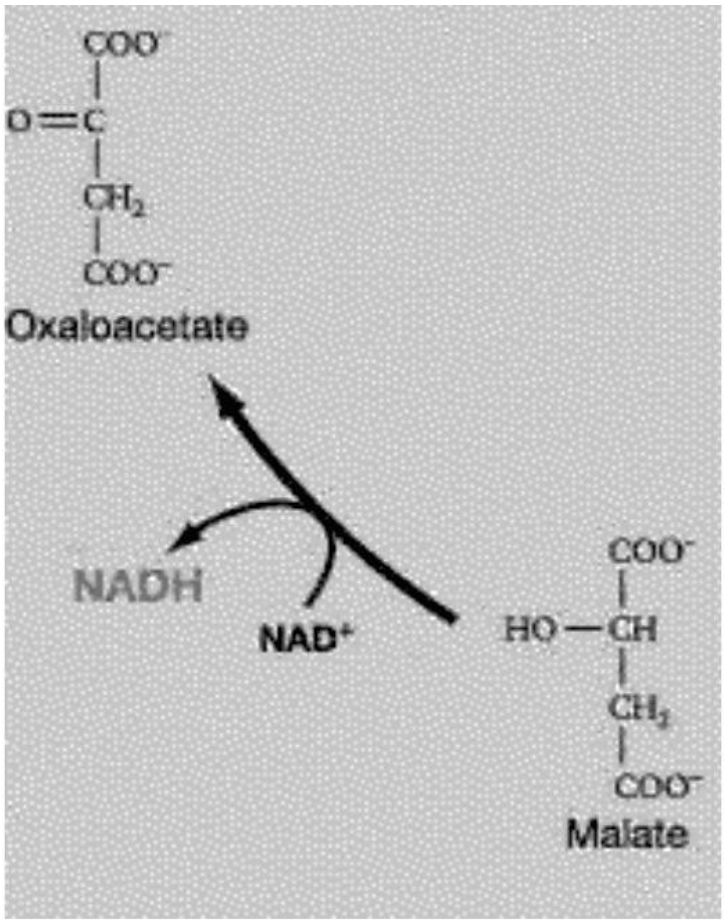


Figure 9.3

19) Refer to Figure 9.3. Which of these statements concerning the following reaction is true?

$$\text{Malate} + NAD^+ \rightarrow \text{oxaloacetate} + NADH + H^+$$

A) Malate is more oxidized than oxaloacetate.
B) Malate is more reduced than oxaloacetate.
C) NAD+ is more reduced than NADH.
D) Oxaloacetate is more reduced than malate.

20) Which of the following events takes place in the electron transport chain?
A) breakdown of glucose into two pyruvate molecules
B) the breakdown of an acetyl group to carbon dioxide
C) the extraction of energy from high-energy electrons remaining from glycolysis and the Krebs cycle
D) substrate-level phosphorylation

21) $C_6H_{12}O_6$ (glucose) + $6O_2 \rightarrow 6\ CO_2 + 6H_2O$
Where is most of the water in this reaction produced?
A) glycolysis
B) Krebs cycle
C) fermentation
D) electron transport chain

22) After glycolysis, but before the Krebs cycle and electron transport chain/oxidative phosphorylation, most of the energy from the original glucose is in the form of which molecule?
A) ATP
B) CO_2
C) H2O
D) NADH
E) pyruvate

23) The electron transport chain
A) is a series of redox reactions.
B) is a series of substitution reactions.
C) is driven by ATP consumption.
D) takes place in the cytoplasm of prokaryotic cells.

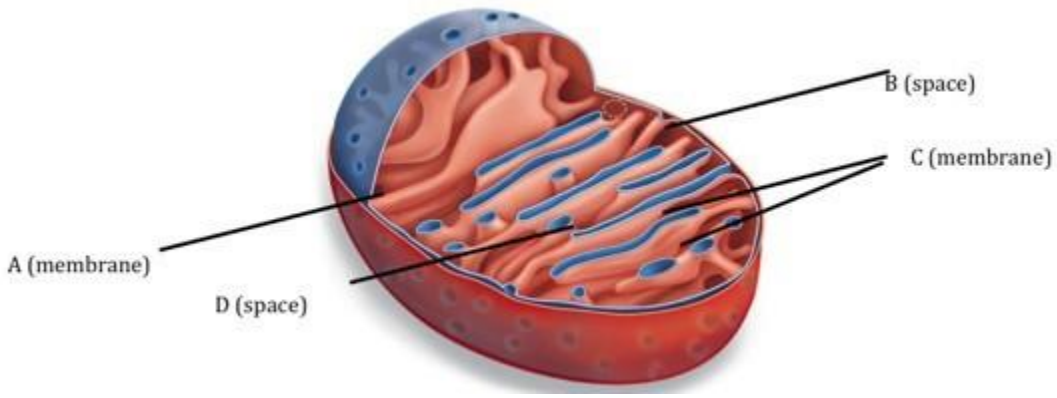
24) The energy of electron transport serves to move (translocate) protons to the outer mitochondrial compartment. How does this help the mitochondrion to produce energy?
A) The hydrogen ions (protons) are transferred to oxygen in an energy-releasing reaction.
B) The translocation of protons sets up the electrochemical gradient that drives ATP synthesis in the mitochondria.
C) The protons pick up electrons from the electron transport chain on their way through the inner mitochondrial membrane.
D) The protons receive electrons from NAD^+ and FAD that are accepted in glycolysis and the Krebs cycle.

25) The inner mitochondrial membrane normally
A) contains permease channels that allow small ions and water to pass readily through the membrane by simple diffusion.
B) contains an active transport pump that pumps protons into the inner mitochondrial compartment from the point of high concentration to a point of lower concentration.
C) is virtually impermeable to hydrogen ions (protons).
D) contains enzymes responsible for two of the chemical reactions that take place as part of glycolysis.

26) Why are fermentation reactions important for cells?
A) They produce alcohol used in alcoholic beverages.
B) They regenerate NAD^+ so that glycolysis can continue.
C) They utilize oxygen.
D) They generate oxygen.

27) Pyruvate oxidation occurs in
A) the cytosol.
B) the mitochondrial intermembrane space.
C) the mitochondrial inner membrane.
D) the mitochondrial matrix.

28) Substrate level phosphorylation occurs in the citric acid cycle when Succinyl CoA is converted to Succinate. Which of the following statements about this event is true?
A) Inorganic phosphate is added to ADP by HS-CoA thereby creating ATP.
B) Inorganic phosphate is used to create GTP. GTP then donates a phosphate group to ADP to create ATP.
C) A phosphate group is removed from HS-CoA and is donated to GDP to form GTP. GTP then donates a phosphate group to ADP to create ATP.



29) In the figure above, where are the enzymes of the Krebs (citric acid) cycle located? Choose the arrow that corresponds.
A) A
B) B
C) C
D) D

30) Fatty acids typically have an even number of carbons. They are catabolized by a process called beta-oxidation. The end-products of the metabolic pathway are acetyl groups of acetyl CoA molecules. What is the most likely fate of the acetyl groups?
A) They directly enter the electron transport chain.
B) They directly enter the energy-yielding stages of glycolysis.
C) They are directly decarboxylated by pyruvate dehydrogenase.
D) They directly enter the Krebs cycle.

31) The constituents of the electron transport chain have similar capabilities, with the exception of ubiquinone (coenzyme Q). What is different about ubiquinone?
A) Ubiquinone is a protein that begins the electron transport chain. It therefore accepts high-energy electrons.
B) Ubiquinone is a protein that serves as a regulator of the speed of redox reactions in the electron transport chain.
C) Ubiquinone is a protein that is a constituent of all cells, prokaryotic or eukaryotic; hence its name.
D) Ubiquinone is lipid soluble and can therefore move through the inner mitochondrial membrane.

32) In cellular respiration, electrons are moved along a series of membrane proteins during the electron transport chain. If there was a mutation in the DNA coding for each of the proton pumps of the electron transport chain such that these proteins became non-functional, what would you predict to occur?
A) Protons would not be moved from the matrix to the intermembrane space and so ATP synthase would not be activated.
B) Protons would no longer be moved from the intermembrane space to the matrix and so ATP synthase would not be activated.
C) NADH and $FADH_2$ would have to donate their electrons directly to ATP synthase in order for ATP synthesis to occur.
D) All electrons would have to be stripped from water instead of NADH and FADH2 to create the proton gradient needed to power ATP synthase.

33) The chemiosmotic hypothesis is an important key to understanding general metabolism because
A) it explains how ATP is synthesized by a proton motive force.
B) it explains how electron transport can fuel substrate-level phosphorylation.
C) it explains the sequence of the electron transport chain molecules.
D) it explains the reduction of oxygen to water in the final steps of oxidative metabolism.

34) Which of the following is FALSE concerning ATP synthase?
A) It generates ATP by chemiosmosis in cellular respiration and photosynthesis.
B) It performs the same function in cellular respiration and photosynthesis, with similar structure and biochemical composition in each.
C) It is an enzyme that is a tiny rotary motor.
D) It is a component of the electron transport chain in cellular respiration and photosynthesis.

35) During the electron transport chain, cytochrome oxidase catalyzes the transfer for electrons from cytochrome c to oxygen in the mitochondria. Cyanide is a poison that inhibits the enzyme cytochrome oxidase. When cyanide is present, what will happen?
A) The electron transport chain will shut down.
B) The Kreb's cycle will no longer synthesize electron carriers.
C) Glycolysis will no longer produce pyruvate.
D) All of the above

36) ATP production by ATP synthase, requiring a proton gradient across a membrane, occurs in which of the following?
A) substrate-level phosphorylation.
B) oxidative phosphorylation
C) photophosphorylation
D) Both A and B.
E) Both B and C

37) Which of the following is true in terms of metabolism?
A) Organisms can be classified as either catabolic or anabolic, but not both.
B) The reversible reaction ADP + Pi = ATP is linked with other reactions in many metabolic pathways.
C) Metabolic reactions first appeared in evolutionary history with the appearance of eukaryotes.
D) Oxidation-reduction reactions occur in eukaryotes, but not in bacteria, nor in archaeans.

$C_6H_{12}O_6 + 6\ O_2 \rightarrow\ 6\ CO_2 + 6\ H_2O$ + Energy

38) Which of the following statements describes the pathway shown above?
A) It is a catabolic pathway.
B) It is an anabolic pathway.
C) It is a set of reactions, each of which is exergonic.
D) It is a pathway that occurs in plants, algae, and some prokaryotes, but not in other organisms (such as animals, fungi).

39) Which metabolic pathway is common to both cellular respiration and fermentation?
A) the oxidation of pyruvate to acetyl CoA
B) the citric acid cycle
C) oxidative phosphorylation
D) glycolysis
E) chemiosmosis

40) The ATP made during fermentation is generated by
A) the electron transport chain.
B) substrate-level phosphorylation.
C) chemiosmosis.
D) oxidative phosphorylation.
E) aerobic respiration.

41) In the absence of oxygen, yeast cells can obtain energy by fermentation, resulting in the production of
A) ATP, CO_2, and ethanol (ethyl alcohol).
B) ATP, CO_2, and lactate.
C) ATP, NADH, and pyruvate.
D) ATP, pyruvate, and oxygen.
E) ATP, pyruvate, and acetyl CoA.

42) Which of the following occurs in the cytosol of a eukaryotic cell?
A) glycolysis and fermentation
B) fermentation and chemiosmosis
C) oxidation of pyruvate to acetyl CoA
D) citric acid cycle
E) oxidative phosphorylation

43) A mutation in yeast makes it unable to convert pyruvate to ethanol. How will this mutation affect these yeast cells? The mutant yeast cells will
A) be unable to grow anaerobically.
B) grow anaerobically only when given glucose.
C) be unable to metabolize glucose.
D) die because they cannot regenerate NAD^+ from NAD.
E) metabolize only fatty acids.