

Guided Reading Questions

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Chapter 6

How Cells Harvest Chemical Energy

- (essay) How do fast and slow muscle fibers differ metabolically? Define aerobically and anaerobically. What is produced by cellular respiration? What is the anaerobic waste product from muscles?
- (6.1) What are the reactants and products of photosynthesis? Of cellular respiration?
- (6.2) Contrast respiration and cellular respiration.
- (6.3) What is the fundamental function of cellular respiration? What is the chemical equation for cellular respiration (see Figure 6.3)? How much of the energy from glucose is converted into ATP? What happens to the rest of the energy?
- (6.4) How much of our daily food intake is used for life sustaining activity? How much glucose would you need to operate for one day?
- (6.5) In cellular respiration, glucose loses hydrogens to become what and oxygen gains hydrogens to become what? Define redox reaction, oxidation and reduction. Is glucose oxidized or reduced during cellular respiration? Is oxygen oxidized or reduced? What is a dehydrogenase? What is NAD^+ ? What is an electron carrier? Define electron transport chain. Note that as electrons are passed “down” the electron hill, energy is released and that the “higher” electron carrier is oxidized while the “lower” one is reduced. What is the final electron acceptor at the end of the electron transport chain in the mitochondrion?
- (6.6) What are the three stages of cellular respiration? Where do glycolysis, the Krebs cycle and the electron transport chain take place? What are the main functions of glycolysis and the Krebs cycle? What two molecules shuttle electrons to the electron transport chain? Define chemiosmosis. What does the enzyme ATP synthase do?
- (6.7) What does “glycolysis” mean? What are the initial reactant and end products of glycolysis? How many steps are there in glycolysis? How is ATP made during glycolysis? How many NAD^+ are reduced during glycolysis? How does substrate-level phosphorylation manufacture ATP? Define intermediates. What are the two phases of glycolysis? Note that ATP is hydrolyzed in steps one and three; this is to render the sugar molecule unstable for step four. How many net ATP are made in glycolysis? How much of the energy from glucose is harvested in ATP and in NADH?
- (6.8) Pyruvate is converted to what molecule before entering the Krebs cycle? What three steps are involved in this transformation? In what organelle does this occur? As what molecule is the waste carbon discarded? How many acetyl~CoA molecules are produced from one glucose molecule?
- (6.9) Where does the Krebs cycle take place? What happens to each acetyl fragment that enters the Krebs cycle? During each turn of the Krebs cycle, how many ATP, NADH and FADH_2 are made? How is ATP produced?
- (6.10) What is the final stage of cellular respiration? How does the membrane make ATP generation possible? Where is the electron transport chain located? How do the cristae increase energy accumulation? What is the final electron acceptor of the electron transport chain? What is the final product from the electron transport chain? How is it formed? Note that the protein complexes use the electrons to **actively transport** H^+ from one side of the

- membrane to the other (Recall the requirements for active transport.) What does the H^+ gradient store? How do the protons (H^+ 's) cross the membrane? What provides the energy to phosphorylate ADP? Why is the process called oxidative phosphorylation?
- (6.11) How does rotenone affect the electron transport chain? How do cyanide and carbon monoxide electron transport chain? What do all three of these compounds have in common? What enzyme does oligomycin inhibit? What effect do uncouplers have on the proton gradient?
- (6.12) How often does the grooming of pyruvic acid and the Krebs cycle occur for each glucose molecule? How is ATP made in glycolysis and the Krebs cycle? How much ATP does the electron transport chain make? How many ATPs are made from one NADH? How many ATPs are made from one $FADH_2$? Note that some energy might be used to shuttle the NADH from glycolysis into the mitochondrion. How many ATPs are made by the complete respiration of one glucose? How much of the total energy in glucose is converted into ATP? Why is O_2 important for cellular respiration?
- (6.13) In what stage of cellular respiration are these ATP produced? When no oxygen is present, how many ATPs do yeast produce from one glucose? What is the function of fermentation step? Where does lactic acid fermentation occur? To what do yeast convert pyruvic acid during alcoholic fermentation? What are two problems with producing ethanol as a waste product? Define strict anaerobes and facultative anaerobes. Why is pyruvic acid like a fork in the road? Why do wine vats have one-way valves?
- (6.14) What metabolic pathway did ancient prokaryotes probably utilize to harvest energy? Why is the process of glycolysis considered to have evolved early?
- (6.15) Into what are starch and glycogen broken down? Into what are proteins decomposed? What functional group must be removed from amino acids before they can be used for energy? How is the amino group discarded? How much more energy is present in one gram of fat compared to one gram of glucose?
- (6.16) What are biosynthetic pathways? What are the three main classes of macromolecules? Are biosynthetic pathways the reverse of energy-harvesting pathways? Note also that ATP is used in biosynthesis. How does feedback inhibition prevent the overproduction of cell components?