

# CHAPTER 13

## HOW CELLS OBTAIN ENERGY FROM FOOD

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### The Breakdown and Utilization of Sugars and Fats

- 13-1** Glycolysis is an anaerobic process used to catabolize glucose. What does it mean for this process to be anaerobic?
- (a) No oxygen is required.
  - (b) No oxidation occurs.
  - (c) It takes place in the lysosome.
  - (d) Glucose is broken down by the addition of electrons.
- 13-2** Which of the following stages in the breakdown of the piece of toast you had for breakfast generates the most ATP?
- (a) the digestion of starch to glucose
  - (b) glycolysis
  - (c) the citric acid cycle
  - (d) oxidative phosphorylation
- 13-3** The advantage to the cell of the gradual oxidation of glucose during cellular respiration compared with its combustion to  $\text{CO}_2$  and  $\text{H}_2\text{O}$  in a single step is that \_\_\_\_\_.
- (a) more free energy is released for a given amount of glucose oxidized
  - (b) no energy is lost as heat
  - (c) energy can be extracted in usable amounts
  - (d) more  $\text{CO}_2$  is produced for a given amount of glucose oxidized
- 13-4** The final metabolite produced by glycolysis is \_\_\_\_\_.
- (a) acetyl CoA
  - (b) pyruvate
  - (c) 3-phosphoglycerate
  - (d) glyceraldehyde 3-phosphate
- 13-5** Glycolysis generates more stored energy than it expends. What is the net number of activated carrier molecules produced in this process (number and type of molecules produced minus the number of those molecules used as input)?
- (a) 6 ATP, 2 NADH
  - (b) 4 ATP, 4 NADH
  - (c) 2 ATP, 2 NADH
  - (d) 4 ATP, 2 NADH

- 13-6** Which of the following steps or processes in aerobic respiration include the production of carbon dioxide?
- (a) breakdown of glycogen
  - (b) glycolysis
  - (c) conversion of pyruvate to acetyl CoA
  - (d) oxidative phosphorylation
- 13-7** In step 4 of glycolysis, a six-carbon sugar (fructose 1,6-bisphosphate) is cleaved to produce two three-carbon molecules (dihydroxyacetone phosphate and glyceraldehyde 3-phosphate). Which enzyme catalyzes this reaction?
- (a) aldolase
  - (b) phosphoglucose isomerase
  - (c) enolase
  - (d) triose phosphate isomerase
- 13-8** On a diet consisting of nothing but protein, which of the following is the most likely outcome?
- (a) loss of weight because amino acids cannot be used for the synthesis of fat
  - (b) muscle gain because the amino acids will go directly into building muscle
  - (c) tiredness because amino acids cannot be used to generate energy
  - (d) excretion of more nitrogenous (ammonia-derived) wastes than with a more balanced diet
- 13-9** Figure Q13-9 represents a cell lining the gut. Draw numbered labeled lines to indicate exactly where inside a cell the following processes take place.

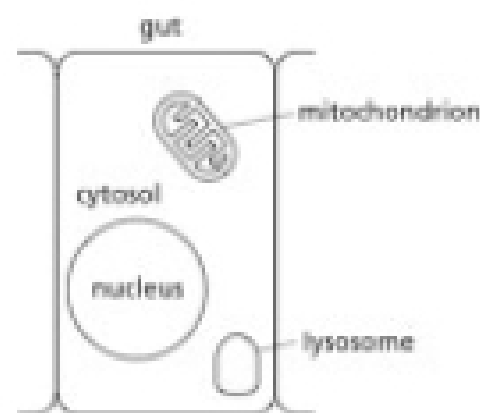
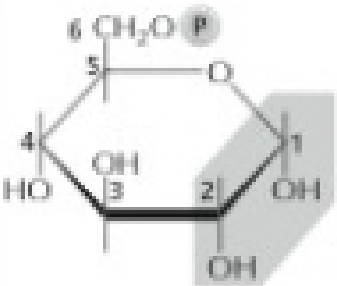
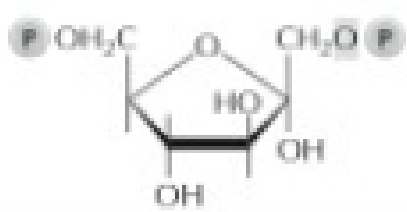

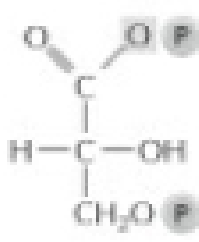
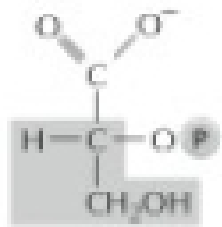


Figure Q13-9

1. glycolysis
2. citric acid cycle
3. conversion of pyruvate to activated acetyl groups
4. oxidation of fatty acids to acetyl CoA
5. glycogen breakdown
6. release of fatty acids from triacylglycerols
7. oxidative phosphorylation

13-10 Fill in the spaces in the table below. For steps 1, 4, 5, and 8, name the correct substrates, enzyme, or products. For all the other steps, name the enzyme and draw the missing structure.

	substrate	enzyme	product(s)
STEP 1	glucose	hexokinase	
STEP 2			
STEP 3			
STEP 4		aldolase	dihydroxyacetone phosphate, glyceraldehyde 3-phosphate
STEP 5		triose phosphate isomerase	
STEP 6			
STEP 7			
STEP 8	3-phosphoglycerate	phosphoglycerate mutase	
STEP 9			
STEP 10			