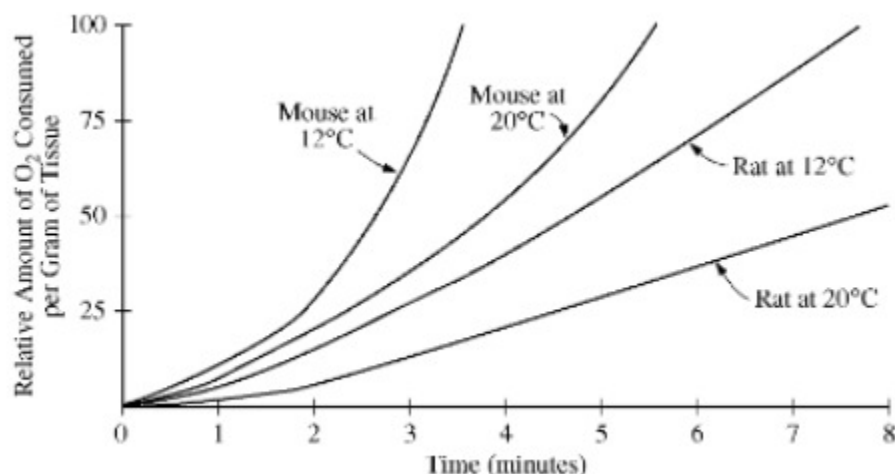


Cell Respiration Part 1

A respirometer is a container used to measure the amount of oxygen consumed by an organism. A respirometer was used to determine how environmental temperature affects the uptake of oxygen in one 300-gram rat and one 50-gram mouse. The results of this experiment are shown on the graph below.



1. Which of the following would most adversely affect the validity of this experiment?

(A) Large variation in metabolic rates between individuals of a species ✓

(B) Repeating the experiment several times

(C) Using a brown rat and a white mouse

(D) Using a thermometer that consistently read 2°C too low

(E) Using a scale that consistently indicated 2 grams too much

2. Which of the following hypotheses is best supported by the results of this experiment?

(A) Metabolic rate per gram of tissue is higher in smaller mammals. ✓

(B) Metabolic rate per gram of tissue is not related to body mass.

(C) Mice produce less CO₂ per gram of tissue than do rats.

(D) Rats consume more food per gram of tissue than do mice.

(E) Rats lose more heat per gram of tissue than do mice.

Cell Respiration Part 1

An experiment to measure the rate of respiration in crickets and mice at 10°C and 25°C was performed using a respirometer, an apparatus that measures changes in gas volume. Respiration was measured in mL of O₂ consumed per gram of organism over several five-minute trials and the following data were obtained.

Organism	Temperature (°C)	Average respiration (mL O ₂ /g/min)
Mouse	10	0.0518
Mouse	25	0.0321
Cricket	10	0.0013
Cricket	25	0.0038

3. According to the data, the mice at 10°C demonstrated greater oxygen consumption per gram of tissue than did the mice at 25°C. This is most likely explained by which of the following statements?

(A) The mice at 10°C had a higher rate of ATP production than the mice at 25°C. ✓

(B) The mice at 10°C had a lower metabolic rate than the mice at 25°C.

(C) The mice at 25°C weighed less than the mice at 10°C.

(D) The mice at 25°C were more active than the mice at 10°C.

4. During aerobic cellular respiration, oxygen gas is consumed at the same rate as carbon dioxide gas is produced. In order to provide accurate volumetric measurements of oxygen gas consumption, the experimental setup should include which of the following?

(A) A substance that removes carbon dioxide gas ✓

(B) A plant to produce oxygen

(C) A glucose reserve

(D) A valve to release excess water

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6. Which metabolic process is common to both aerobic cellular respiration and alcoholic fermentation?

(A) Krebs cycle

(B) Glycolysis ✓

(C) Electron transport chain

(D) Conversion of pyruvic acid to acetyl CoA

(E) Production of a proton gradient

7. The reactions of glycolysis occur in the

(A) cytosol ✓

(B) nucleus

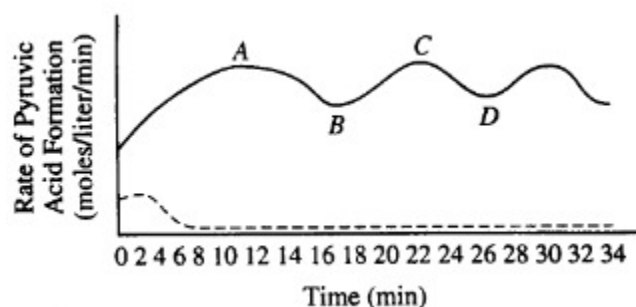
(C) matrix of the mitochondrion

(D) membranes of the mitochondrion

(E) stroma of the chloroplast

Cell Respiration Part 1

- **Directions:** Each group of questions below concerns an experimental or laboratory situation or data. In each case, first study the description of the situation or data. Then choose the one best answer to each question following it.



A tissue culture of vertebrate muscle was provided with a constant excess supply of glucose under anaerobic conditions starting at time zero and the amounts of pyruvic acid and ATP produced were measured. The solid line in the graph above represents the pyruvic acid produced in moles per liter per minute. ATP levels were also found to be highest at points *A* and *C*, lowest at *B* and *D*. A second culture was set up under the same conditions, except that substance **X** was added, and the results are indicated by the dotted line.

8. Which of the following is most likely to result if oxygen is added to the tissue culture?
- (A) Lactic acid formation will increase.
- (B) For each glucose molecule consumed, more ATP will be formed. ✓
- (C) The levels of ATP produced will decrease.
- (D) Ethyl alcohol will be produced.
- (E) No change in the production of pyruvic acid will be observed.
9. When hydrogen ions are pumped out of the mitochondrial matrix, across the inner mitochondrial membrane, and into the space between the inner and outer membranes, the result is
- (A) damage to the mitochondrion
- (B) the reduction of NAD
- (C) the restoration of the Na-K balance across the membrane
- (D) the creation of a proton gradient ✓
- (E) the lowering of pH in the mitochondrial matrix

Cell Respiration Part 1

- **Directions:** This group of questions consists of five lettered headings followed by a list of phrases or sentences. For each phrase or sentence, select the one heading to which it is most closely related. Each heading may be used once, more than once, or not at all.

- (A) Glycolysis
- (B) Krebs cycle (citric acid cycle)
- (C) Calvin cycle (light-independent reactions of photosynthesis)
- (D) Light-dependent reactions of photosynthesis
- (E) Chemiosmosis

10. Process in which sugar is oxidized to pyruvic acid

(A) A



(B) B

(C) C

(D) D

(E) E

11. Process in which CO_2 is released as a by-product of oxidation-reduction reactions

(A) A

(B) B



(C) C

(D) D

(E) E

Cell Respiration Part 1

Certain chemicals, including sodium fluoride (NaF), are capable of inhibiting specific steps of glycolysis. Figure 1 shows the steps of the glycolysis pathway, indicating where various macromolecules enter the pathway as well as the specific reaction inhibited by NaF.

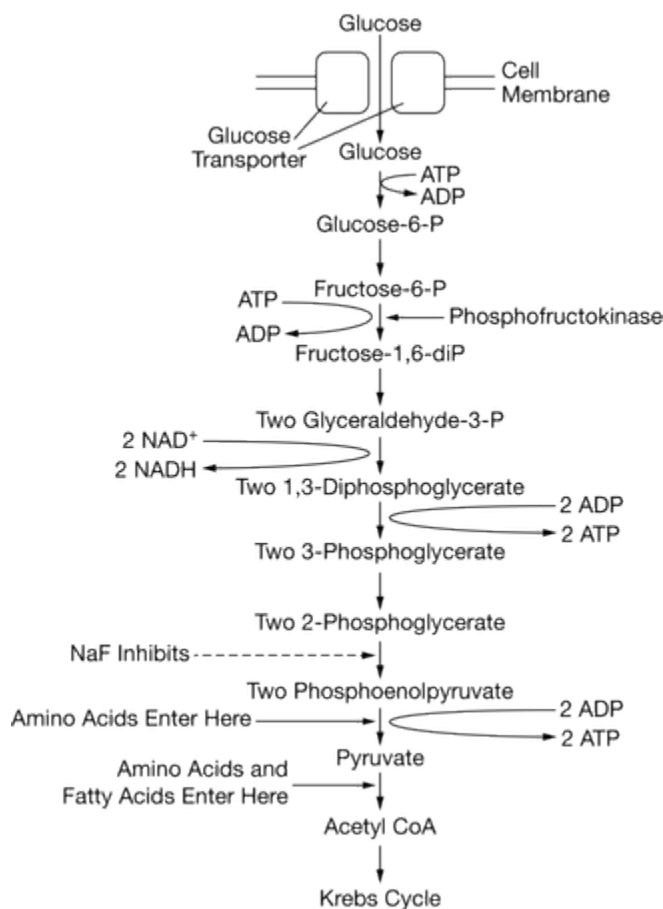


Figure 1. Key steps in the metabolic pathway of glucose

12. Tarui disease is an inherited disorder that is caused by mutations in *PFKM*, the gene that encodes a subunit of phosphofructokinase, an enzyme in the glycolysis pathway. Individuals with Tarui disease produce little or no functional phosphofructokinase in skeletal muscle cells. Based on Figure 1, which of the following best explains why a low carbohydrate diet is recommended for those with Tarui disease?
- (A) Carbohydrates are capable of undergoing lactic acid fermentation, and amino acids and fatty acids are not.
 - (B) Carbohydrate metabolism requires all the reactions of glycolysis, and amino acids and fatty acids do not. ✓
 - (C) Carbohydrates cannot be used to synthesize important metabolic enzymes like amino acids and fatty acids can be.
 - (D) Carbohydrates cannot be stored, while amino acids and fatty acids can be.

Cell Respiration Part 1

13. Based on Figure 1, the net number of ATP molecules produced during glycolysis from the metabolism of a single glucose molecule is closest to which of the following?
- (A) 0
- (B) 2 ✓
- (C) 4
- (D) 8
14. Two nutrient solutions are maintained at the same pH. Actively respiring mitochondria are isolated and placed into each of the two solutions. Oxygen gas is bubbled into one solution. The other solution is depleted of available oxygen. Which of the following best explains why ATP production is greater in the tube with oxygen than in the tube without oxygen?
- (A) The rate of proton pumping across the inner mitochondrial membrane is lower in the sample without oxygen. ✓
- (B) Electron transport is reduced in the absence of a plasma membrane.
- (C) In the absence of oxygen, oxidative phosphorylation produces more ATP than does fermentation.
- (D) In the presence of oxygen, glycolysis produces more ATP than in the absence of oxygen.
15. Which of the following describes a metabolic consequence of a shortage of oxygen in muscle cells?
- (A) An increase in blood pH due to the accumulation of lactic acid
- (B) No ATP production due to the absence of substrate-level phosphorylation
- (C) A buildup of lactic acid in the muscle tissue due to fermentation ✓
- (D) A decrease in the oxidation of fatty acids due to a shortage of ATP
16. Students in a class measured the mass of various living organisms. They then kept the organisms in the dark for 24 hours before remeasuring them. None of the organisms were provided with nutrients during the 24-hour period. The data are as follows.

Organism	Starting Mass (g)	Final Mass (g)
<i>Elodea</i> (submerged aquatic plant)	15.10	14.01
Goldfish	10.10	9.84
Sea anemone	25.60	24.98

Which of the following is the best explanation for the pattern of change in mass of the organisms over time?

Cell Respiration Part 1

(A) Water loss due to evaporation

(B) Cellular respiration

(C) The law of conservation of matter

(D) Growth and reproduction

17. Within the cell, many chemical reactions that, by themselves, require energy input (have a positive free-energy change) can occur because the reactions

(A) may be coupled to the hydrolysis of ATP

(B) take place very slowly

(C) take place when the cells are at unusually high temperatures

(D) are catalyzed by enzymes

(E) are aided by various metal ions that act as catalysts

18. Which of the following best describes the function of the coenzymes NAD^+ and FAD in eukaryotic cellular respiration?

(A) They participate in hydrolysis reactions by accepting protons from water molecules.

(B) They participate directly in the phosphorylation of ADP to ATP.

(C) They serve as final electron acceptors in the electron transport chain.

(D) They aid vitamins such as niacin in the breakdown of glucose.

(E) They accept electrons during oxidation-reduction reactions.