

CELLULAR RESPIRATION

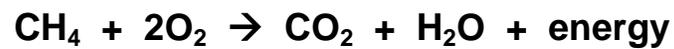
SUMMARY EQUATION

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STEPWISE REDOX REACTION

Oxidation:

Reduction:



ROLE OF NAD⁺

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PHOSPHORYLATION

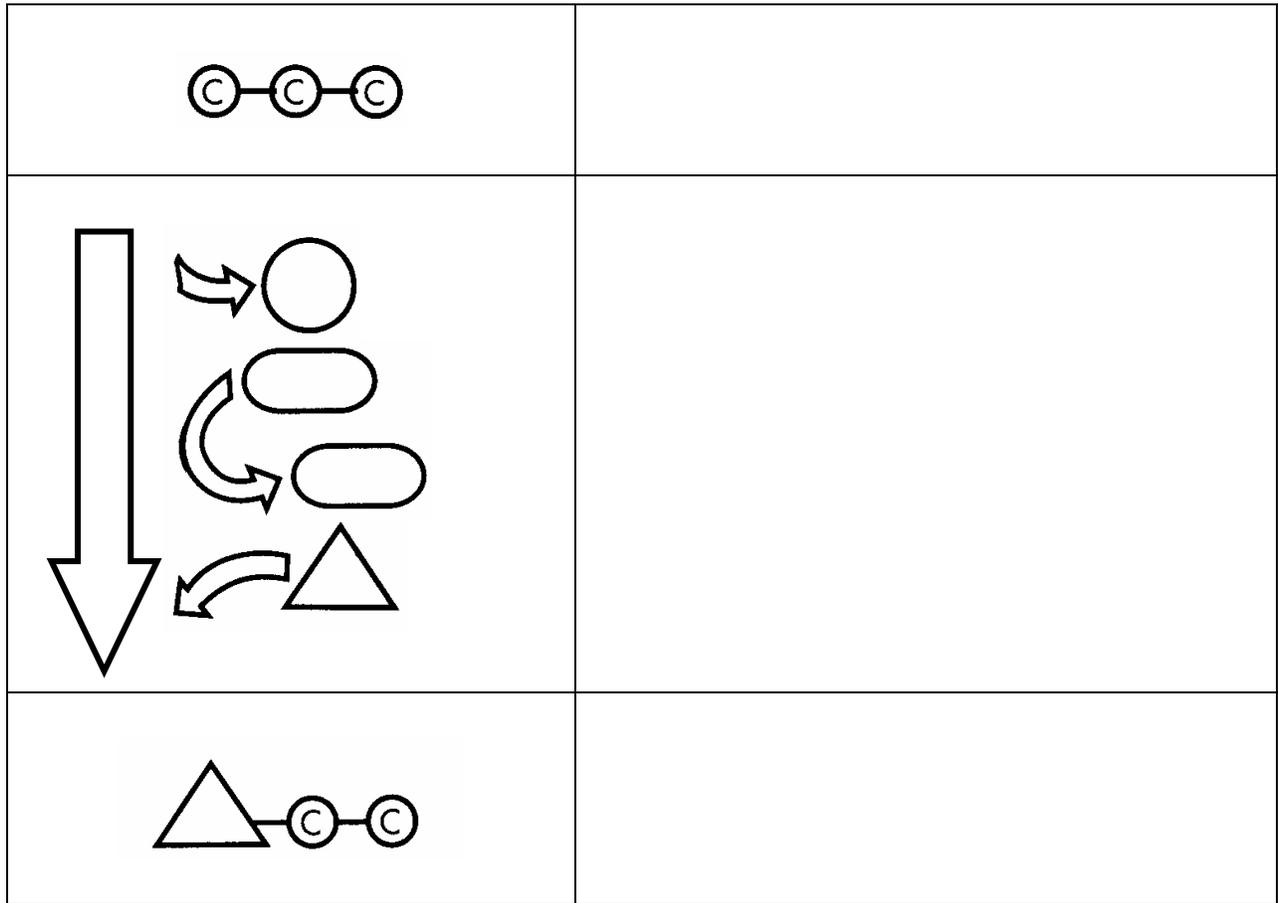
SUBSTRATE LEVEL	OXIDATIVE

STRUCTURE OF MITOCHONDRION

GLYCOLYSIS SUMMARY

ENERGY INVESTMENT	
ENERGY YIELDING	
IN	OUT

KREBS CYCLE – ACETYL CoA PREP



ACETYL Co A PREP PER PYRUVATE

In	OUT

ACETYL Co A PREP PER GLUCOSE

In	OUT

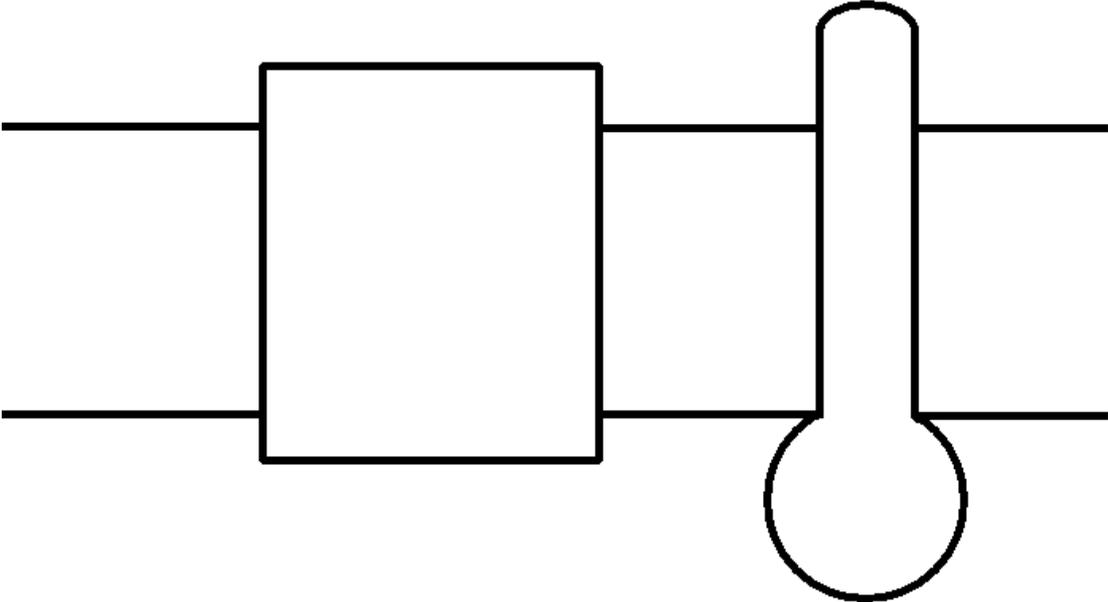
KREBS CYCLE SUMMARY PER PYRUVATE

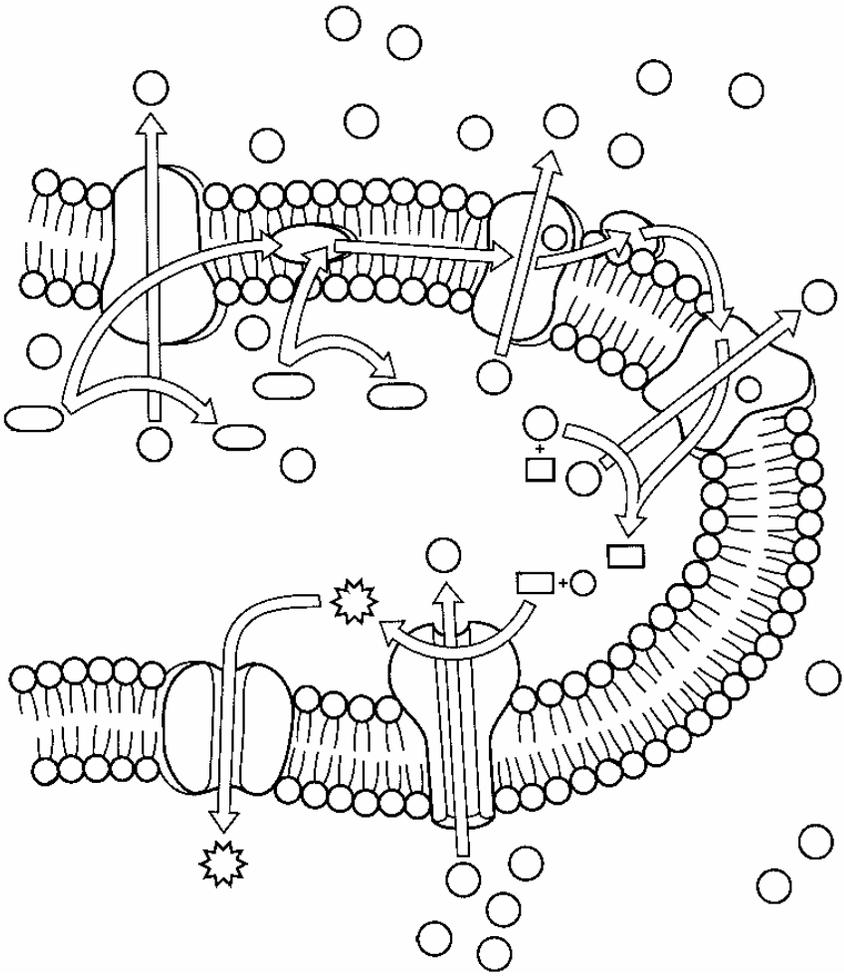
KREBS CYCLE IN	KREBS CYCLE OUT

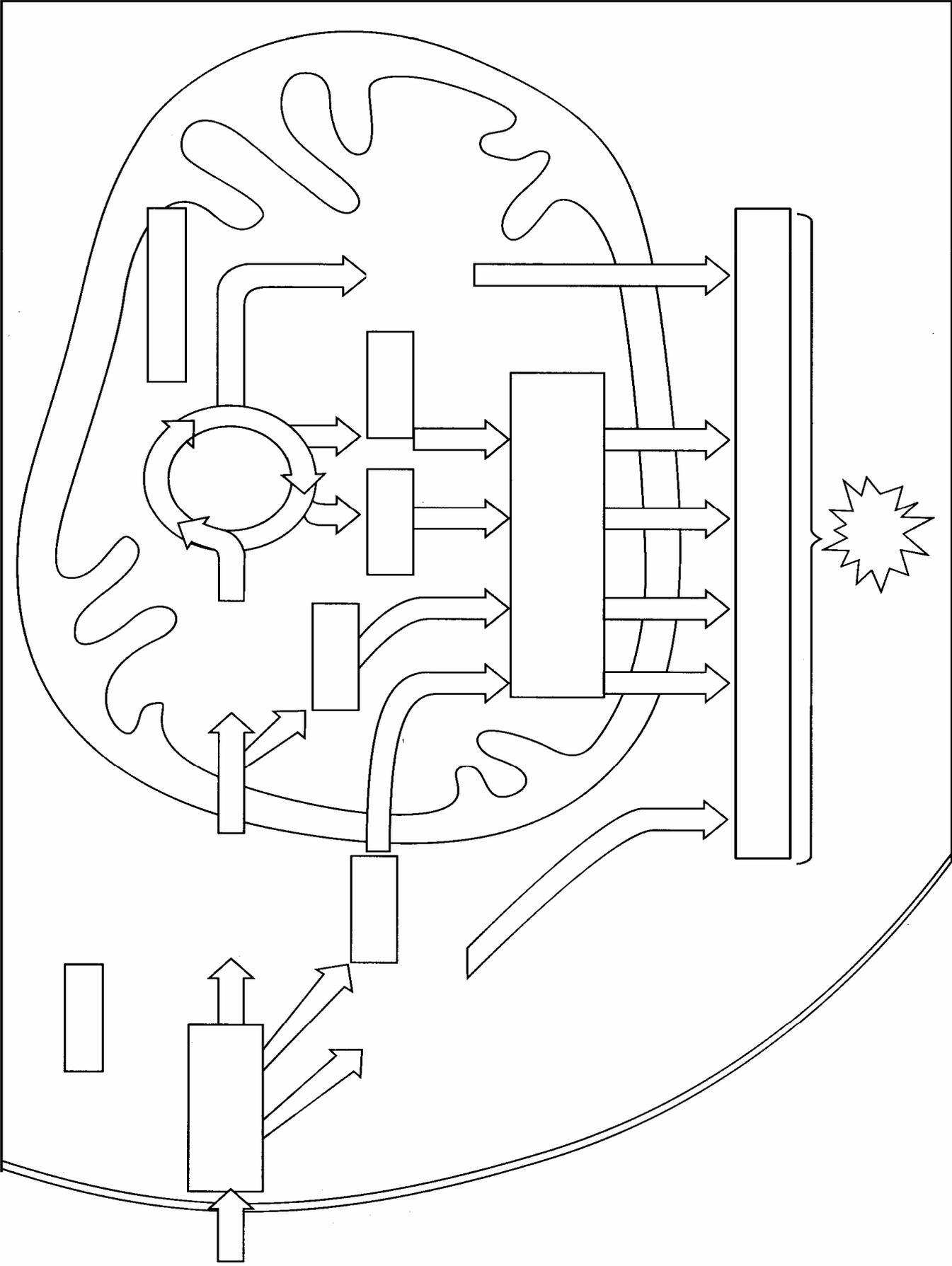
KREBS CYCLE SUMMARY PER GLUCOSE

KREBS CYCLE IN	KREBS CYCLE OUT

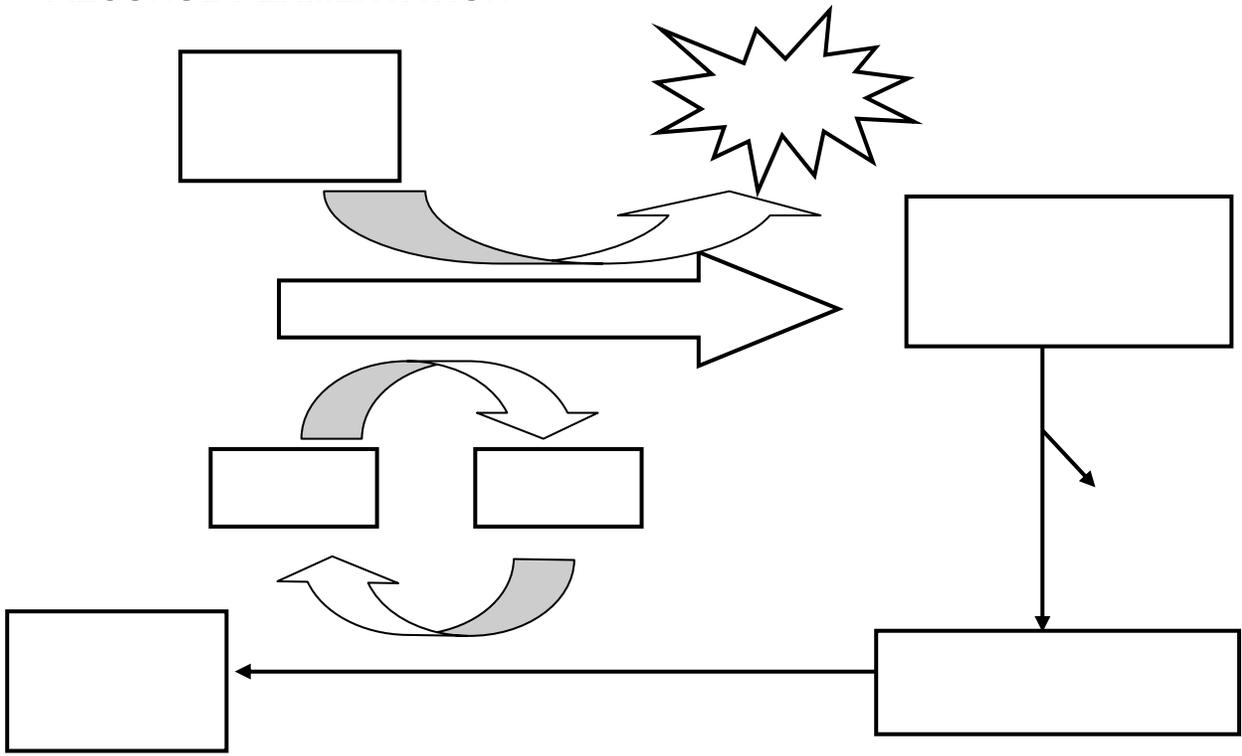
ELECTRON TRANSPORT & OXIDATIVE PHOSPHORYLATION



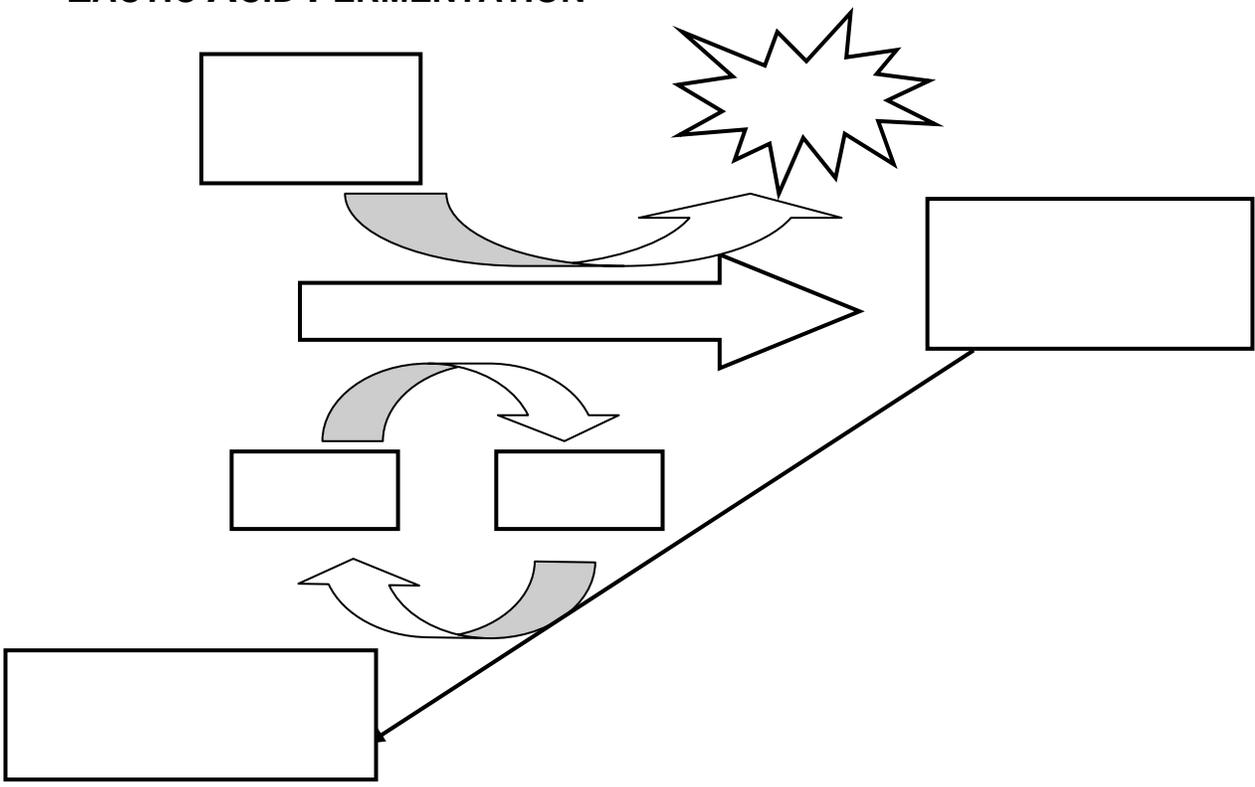




ALCOHOL FERMENTATION



LACTIC ACID FERMENTATION



QUESTIONS

1. Use Figure 9.1 on page 148 in your textbook to answer the following questions.

a. In general, describe what happens during photosynthesis.

b. What are the reactants in photosynthesis?

c. What are the products of photosynthesis?

d. Where in the cell does photosynthesis occur? _____

e. In general, describe what happens during cellular respiration.

f. What are the reactants in cellular respiration?

g. What are the products of cellular respiration?

h. What substance(s) is(are) recycled? _____

i. What substance(s) is(are) not recycled? _____

j. Which reaction (photosynthesis or cellular respiration) is:

Anabolic? _____

Catabolic? _____

Exergonic? _____

Endergonic? _____

2. Write the summary equation for cellular respiration.

3. Most commonly glucose is represented as the molecule broken down in the respiration equation. Does this mean that glucose is the only source of energy (fuel) in cellular respiration? Explain.

4. Define:

a. Oxidation: _____

b. Reduction: _____

5. Cellular respiration is described as a stepwise redox reaction.

a. What substance is oxidized? _____

b. What substance is reduced? _____

6. What happens to the amount of potential energy of electrons as they shift from carbon and hydrogen toward oxygen in cellular respiration?

How is the energy used? _____

7. What is the role of NAD⁺ in cellular respiration?

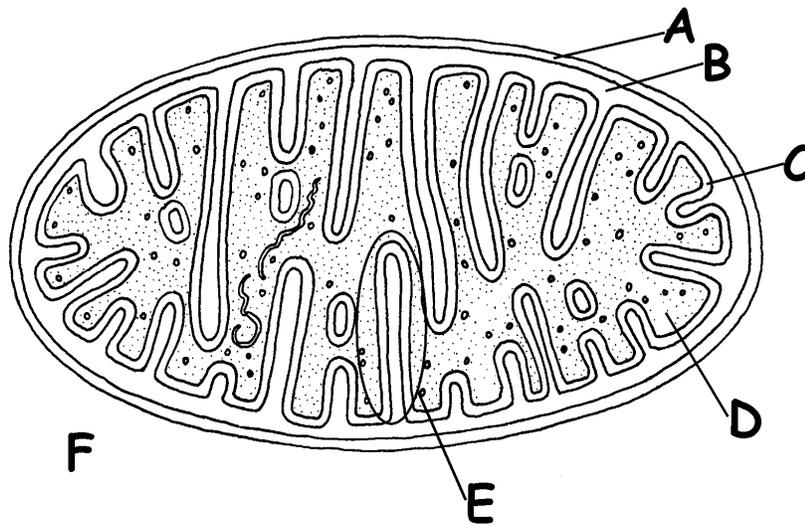
8. What are dehydrogenases? _____

What is their role in cellular respiration? _____

9. Indicate if each of the following characteristics / descriptions is true of **Substrate-level** and **Oxidative phosphorylation**.

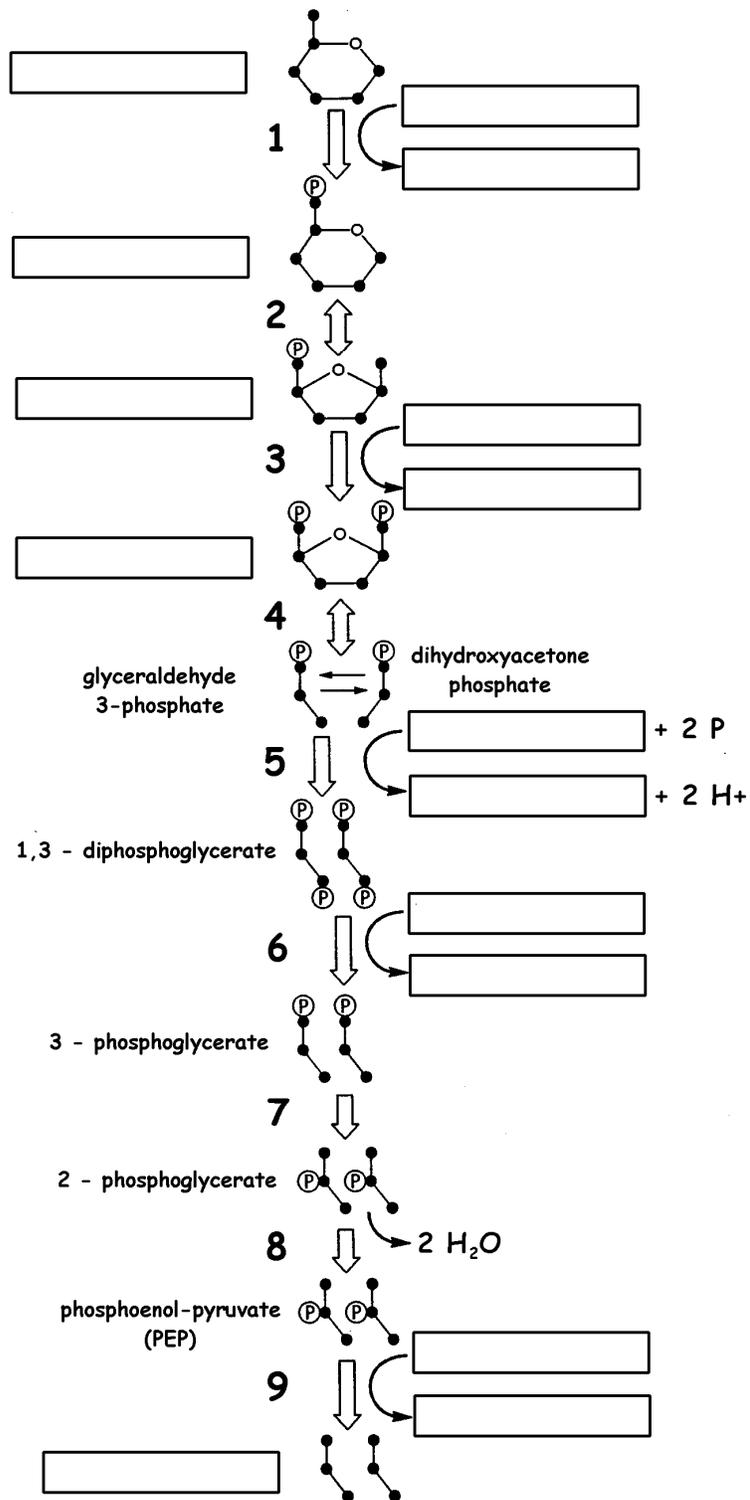
- _____ Produce ATP by adding a phosphate to ADP
- _____ Involves the direct transfer of a phosphate from an intermediate to ADP
- _____ Couples the addition of a phosphate to ADP with the exergonic slide of electrons down the electron transport chain
- _____ Oxygen used as the terminal electron acceptor
- _____ Accounts for 90% of ATP production in aerobic respiration

10. Use the diagram below to answer the questions that follow:



- | | |
|--|---------------------------|
| _____ Outer membrane | _____ Inner membrane |
| _____ Cytoplasm | _____ Matrix |
| _____ Intermembrane space | _____ Crista |
| _____ Site of glycolysis | _____ Site of Krebs cycle |
| _____ Location of electron transport chain | _____ High $[H^+]$ |
| _____ Location of ATP synthase molecules | |

11. Fill in the missing labels on the diagram below.



12. Use the diagram in Question 11 to answer the following questions.
- What process is occurring in the diagram? _____
 - Which step(s) show the transfer of a P (phosphate) from ATP to an intermediate? _____
 - Which step shows a reduction reaction? _____
 - Which steps are included in the energy-investment phase?

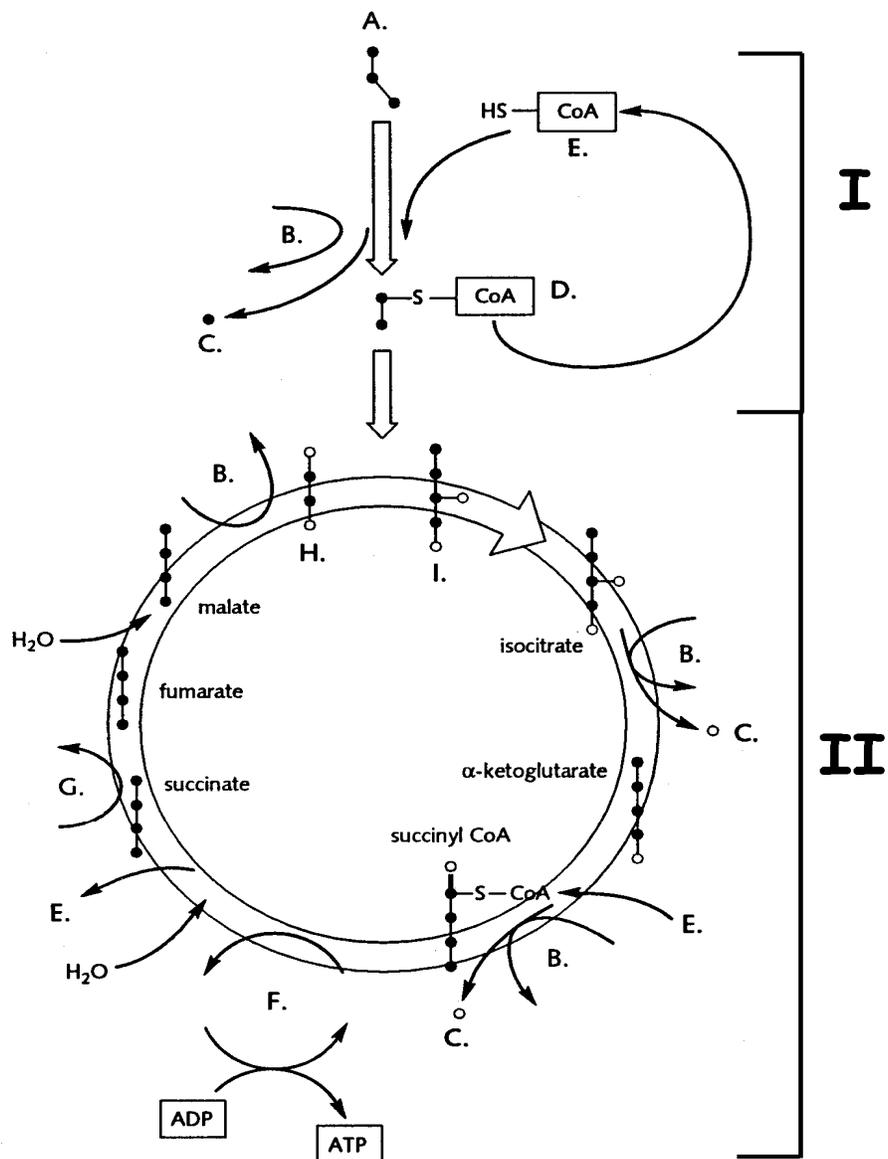
 - Which steps are included in the energy-yielding phase?

 - Which step shows the splitting of a 6-C compound into two 3-C compounds? _____
 - How many ATP molecules, per glucose, are used in this series of reactions? _____
 - How many NADH, per glucose, are produced? _____
 - How many ATP, per glucose, are produced? _____
13. Identify whether each of the following occurs during the energy-investment phase (**EI**) of glycolysis or the energy-yielding phase (**EY**).
- _____ 2 glyceraldehyde phosphates are oxidized
 - _____ 2 NAD⁺ are reduced to 2 NADH
 - _____ Substrate-level phosphorylation occurs
 - _____ $4 \text{ ADP} + 4 \text{ P} \rightarrow 4 \text{ ATP}$
 - _____ 2 ATP molecules are used
 - _____ Glucose & intermediate compounds are phosphorylated
 - _____ Fructose 1,6-diphosphate split into two 3-C compounds

14. List the reactants and products of glycolysis.

Reactants	Products

15. Use the diagram below to answer the questions that follow:



- a. Identify the molecule represented by each of the following letters in the diagram.

A		F	
B		G	
C		H	
D		I	
E			

- b. What process is occurring in the series of reactions labeled I?

Where do these reactions occur within the cell (be specific)?

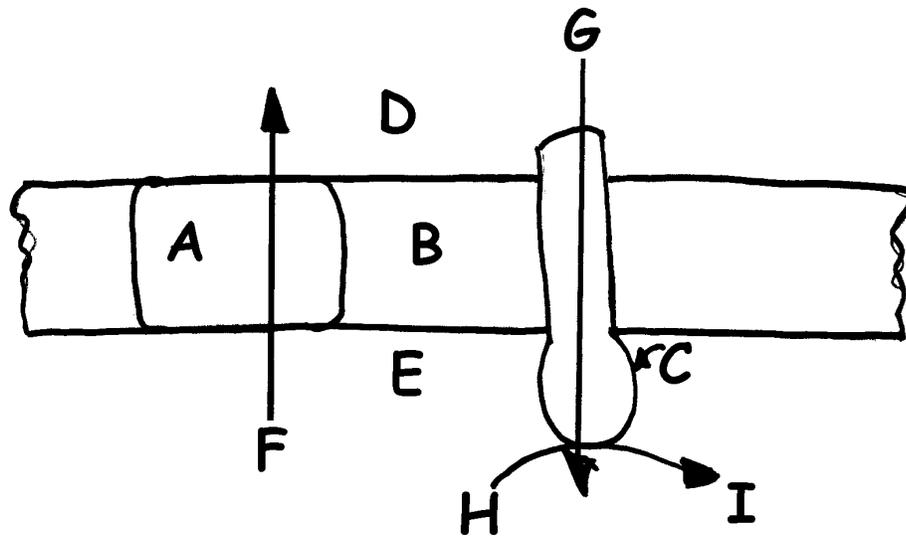
- c. Complete the following chart by providing the number of each molecule produced per glucose molecule.

Molecule	# Produced per glucose	Molecule	# Produced per glucose
NADH		ATP	
CO₂		FADH₂	

16. What are the reactants and products of the Krebs cycle?

Reactants	Products

17. Use the diagram below to answer the questions that follow.



a. Identify the molecules/parts represented by each letter in the diagram.

A		G	
B		H	
C		I	
F			

b. Where is this structure located within the cell (be specific)?

- c. Which letter represents:
- High H⁺ concentration? _____
- Low H⁺ concentration? _____
- Mitochondria matrix? _____
- Inner membrane? _____
- Intermembrane space? _____

- d. Describe what is happening in this diagram.
- _____
- _____
- _____
- _____

18. Put the following steps in the correct order. (Use Figure 9-13 p. 158 for help.)

- _____ Water forms
- _____ NADH oxidized
- _____ Flavoprotein oxidized
- _____ Fe-S protein oxidized
- _____ Flavoprotein reduced
- _____ Fe-S protein reduced
- _____ Ubiquinone reduced
- _____ Oxygen reduced
- _____ cyt a₃ passes electrons to oxygen
- _____ Ubiquinone passes electrons to cytochromes
- _____ Reduced oxygen picks up 2 H⁺

19. As electrons are transported through the electron transport chain to oxygen, they lose potential energy. This energy is used to do what work?

20. The electrons from 1 NADH results in the production of 3 ATP molecules while the electrons from 1 FADH₂ results in the production of 2 ATP molecules. Why is there a difference?

21. Each NADH generated during glycolysis results in the production of 2ATP molecules while each NADH generated during the Krebs cycle results in the production of 3 ATP molecules. Why is there a difference?

22. What are the reactants and products of electron transport & oxidative phosphorylation?

Reactants	Products

23. Account for the 36 ATP molecules produced from the complete oxidation of 1 glucose molecule.

24. Some desert animals such as the kangaroo rat never have to drink water. Explain how kangaroo rats can obtain the water they need to survive from the dry seeds they eat.

25. How is aerobic respiration different from anaerobic respiration?

Aerobic Respiration	Anaerobic Respiration

26. Describe what happens during lactic acid fermentation.

27. Describe what happens during alcohol fermentation.

28. Define the following terms:

Strict Aerobes	
Strict Anaerobes	
Facultative Anaerobes	

29. Carbohydrates, fats, and proteins can all be used as fuel for cellular respiration. Trace the path of each of these food groups from the point of digestion in the intestines to where and in what form they enter cellular respiration.

Carbohydrates	
Fats	
Proteins	