

SAT BIOLOGY PRACTICE PAPER

1. A biome that contains a layer of permanently frozen soil, called permafrost, would be classified as
- A. taiga
 - B. desert
 - C. tundra
 - D. savannah
 - E. temperate deciduous forest
2. All of the following can be considered decomposers EXCEPT
- A. fungi
 - B. bacteria
 - C. hyenas
 - D. earthworms
 - E. dung beetles
3. Which pair of organisms is likely to engage in interspecific resource competition?
- A. Hare and rat
 - B. Rat and beetle
 - C. Hawk and tree
 - D. Deer and hare
 - E. Hawk and hare
4. In a single ecosystem, two similar species can coexist peacefully as long as they do not share the same
- A. niche
 - B. predators
 - C. mutations
 - D. ecosystem
 - E. pheromones
5. *Myriophyllum spicatum*, or water milfoil, native to Eurasia, is an aggressive, invasive aquatic plant in North America. All of the following are reasons this species is successful as an invasive species EXCEPT
- A. milfoil evolved from North American plant species
 - B. milfoil has few natural predators in a nonnative environment
 - C. milfoil has few natural competitors among North American plant species
 - D. milfoil is a hardy plant capable of succeeding in harsher environments
 - E. milfoil is resistant to many native diseases that are adapted to native plant species
6. An example of a secondary consumer is
- A. a fish that feeds on algae
 - B. a hawk that feeds on a mouse that feeds on an insect

- C. a plant that is parasitic to another plant
- D. a lion that eats a gazelle that feeds on grass
- E. a beetle that feeds on nectar

7. Which of the following is considered a biotic factor capable of influencing a plant species's population growth?

I. Intraspecies competition

II. Predation

III. Nutrient availability

- A. I only
- B. II only
- C. III only
- D. I and II
- E. II and III

8. A lake filled with algae that are choking out aquatic plants and fish is likely experiencing which process?

- A. Succession
- B. Eutrophication
- C. Denitrification
- D. Carbon fixation
- E. Acid rain runoff

9. In a tropical food web, 800,000 kJ of energy are produced by autotrophic species. Approximately how much energy will exist at the level of secondary consumers?

- A. 80 kJ
- B. 800 kJ
- C. 8,000 kJ
- D. 80,000 kJ
- E. 800,000 kJ

10. Nitrogen-fixing bacteria are most likely found in which environment?

- A. Stomach of a reptile
- B. Lower epidermis of leaves
- C. Gills of freshwater fish
- D. Large intestine of humans
- E. Root systems of plants

11. Plants that inhabit warm, dry environments have evolved which of the following adaptations?

I. Conversion of carbon dioxide to a four-carbon compound

II. Stomata that remain closed throughout the night

III. Photorespiration

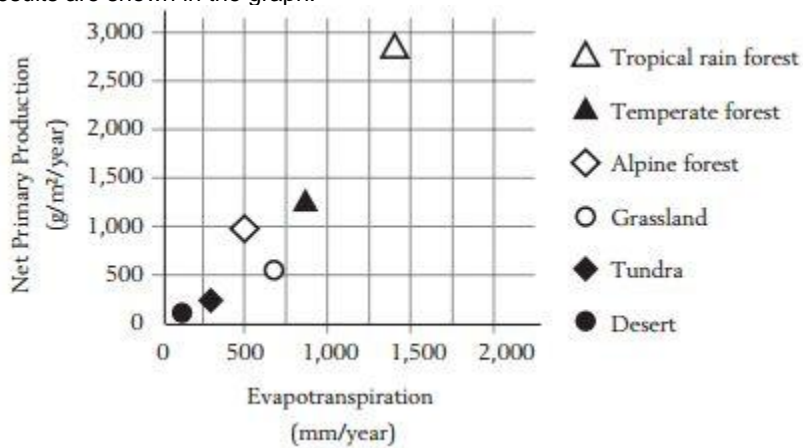
- A. I only
- B. II only

- C. I and II
- D. II and III
- E. I and III

12. A grassy field experiences an increase in growth in an area where phosphorus has been added. However, no such growth occurs in a second area to which nitrogen has been added. Which is a limiting nutrient for this ecosystem?

- A. Nitrogen, because addition of this nutrient did not affect plant growth
- B. Phosphorus, because addition of this nutrient did not affect plant growth
- C. Nitrogen, because addition of this nutrient resulted in increased plant growth
- D. Phosphorus, because addition of this nutrient resulted in increased plant growth
- E. Both nitrogen and phosphorus, because addition of one nutrient increased plant growth

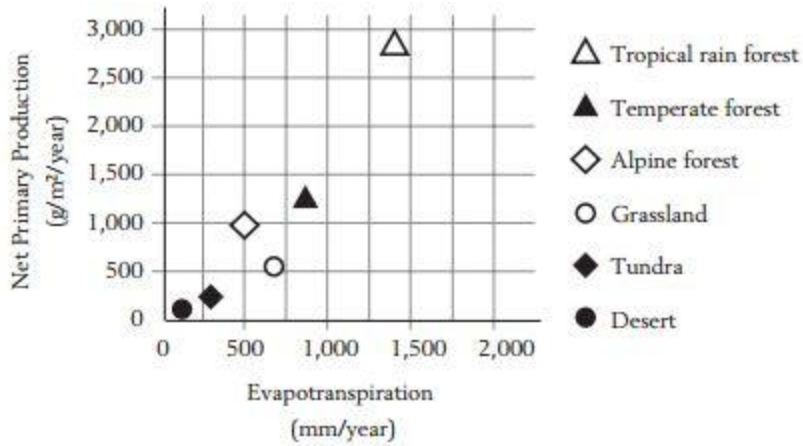
13. Ecologists measured the evapotranspiration and net primary production of different ecosystem types. Their results are shown in the graph.



How many ecosystem types have a higher rate of evapotranspiration than grassland?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

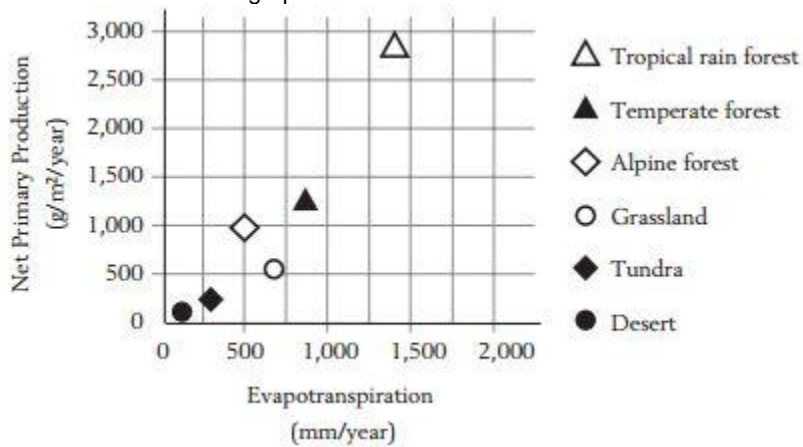
14. Ecologists measured the evapotranspiration and net primary production of different ecosystem types. Their results are shown in the graph.



How much plant biomass is added to a square meter of temperate forest in one month?

- A. 100 g
- B. 500 g
- C. 1,000 g
- D. 1,200 g
- E. 1,500 g

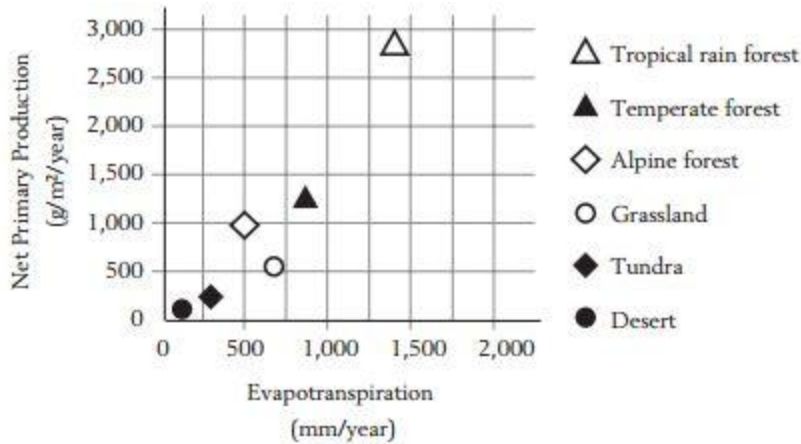
15. Ecologists measured the evapotranspiration and net primary production of different ecosystem types. Their results are shown in the graph.



Which factor leads to a higher rate of net primary production?

- A. Biodiversity
- B. Competition
- C. Elevation
- D. Latitude
- E. Precipitation

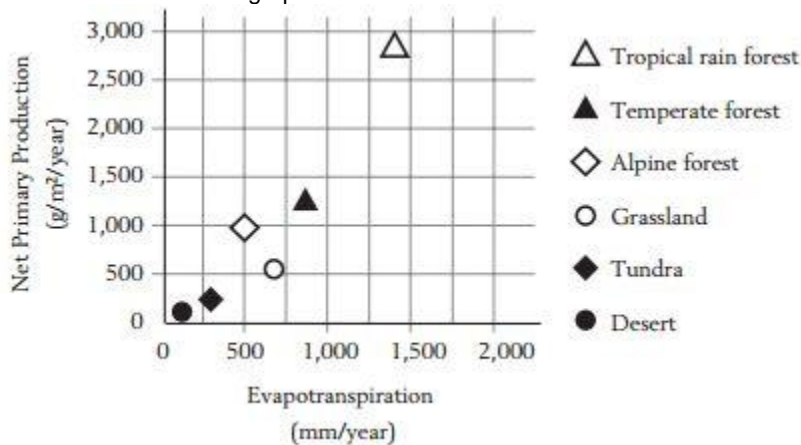
16. Ecologists measured the evapotranspiration and net primary production of different ecosystem types. Their results are shown in the graph.



According to the chart, which best describes the relationship between solar energy and net primary production?

- A. Solar energy is unrelated to net primary production.
- B. Solar energy is positively correlated with net primary production.
- C. Solar energy is negatively correlated with net primary production.
- D. Solar energy increases net primary production where water is not limited.
- E. Solar energy increases net primary production by increasing evapotranspiration.

17. Ecologists measured the evapotranspiration and net primary production of different ecosystem types. Their results are shown in the graph.



The graph shows net primary production. Based on the data, which biome could potentially have a gross primary production rate equivalent to 500 grams per square meter per year?

- A. Tropical rain forest
- B. Temperate forest
- C. Alpine forest
- D. Grassland
- E. Tundra

18. In a long-running ecological study, the species richness of mosses, shrubs, and trees was calculated for one hectare (10,000 m²) of land every 50 years for 200 years. The data are shown in the table.

YEAR	MOSSES	SHRUBS	TREES
1800	16	2	0
1850	21	7	4
1900	10	5	3
1950	13	12	6
2000	17	28	14

What ecological process do the data suggest is occurring?

- A. Evolution
- B. Succession
- C. Destabilization
- D. Primary growth
- E. Artificial selection

19. In a long-running ecological study, the species richness of mosses, shrubs, and trees was calculated for one hectare (10,000 m²) of land every 50 years for 200 years. The data are shown in the table.

YEAR	MOSSES	SHRUBS	TREES
1800	16	2	0
1850	21	7	4
1900	10	5	3
1950	13	12	6
2000	17	28	14

During which time period do the data suggest this area may have experienced a natural disaster?

- A. 1750-1800
- B. 1800-1850
- C. 1850-1900
- D. 1900-1950
- E. 1950-2000

20. In a long-running ecological study, the species richness of mosses, shrubs, and trees was calculated for one hectare (10,000 m²) of land every 50 years for 200 years. The data are shown in the table.

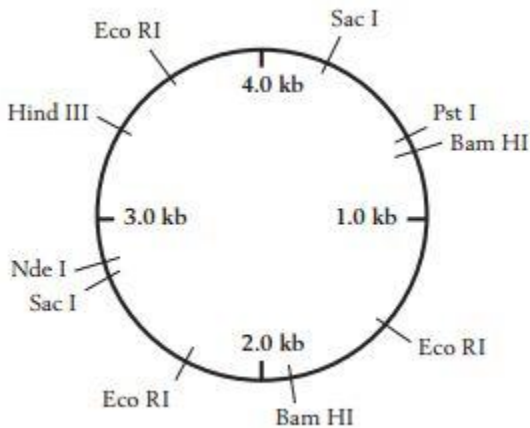
YEAR	MOSSES	SHRUBS	TREES
1800	16	2	0
1850	21	7	4

1900	10	5	3
1950	13	12	6
2000	17	28	14

According to the data, has this community reached a climax?

- A. Yes; all densities continue to change.
- B. No; there is continual change in species' densities.
- C. Yes; moss species are constantly present throughout time.
- D. No; moss species are always present in high densities.
- E. Yes; in 1800 there are relatively many more tree species found.

21. The table shows the restriction enzyme recognition sites present on a circular piece of DNA 4.0 kilobases (1 kb = 1,000 bases) long.



Which pair of restriction enzymes, used together, would produce a band that travels the farthest on an electrophoresis gel?

- A. Nde I and Pst I
- B. Nde I and Eco RI
- C. Sac I and Bam HI
- D. Eco RI and Hind III
- E. Bam HI and Hind III

22. Which of the following is generally identical in all the somatic cells of an organism?

- I. DNA sequences
- II. Protein structures
- III. RNA sequences

- A. I only
- B. II only

- C. III only
- D. I and II
- E. I and III

23. Red blood cells placed in a hypotonic solution will

- A. shrink due to osmotic water loss
- B. rupture due to the influx of water
- C. maintain their shape due to the cell wall
- D. swell but avoid rupturing due to the cell wall
- E. pump out excess water with the contractile vacuole

24. Animals store energy in which of the following molecular forms?

I. Glucose

II. Glycogen

III. Lipid

IV. Protein

- A. I and II
- B. II and III
- C. I, II, and III
- D. II, III, and IV
- E. I, II, III, and IV

25. In which phase of the cell cycle does DNA replication take place?

- A. G₀
- B. G₁
- C. G₂
- D. M
- E. S

26. In eukaryotic cells, chromosomes and ribosomes share which of the following characteristics?

I. They consist of nucleic acid.

II. They consist of protein.

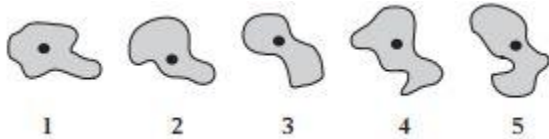
III. They are in the nucleus.

- A. I only
- B. II only
- C. III only
- D. I and II
- E. I and III

27. Which of the following is a macromolecule composed of amino acid subunits?

- A. Amylase
- B. Glycogen
- C. Phospholipid
- D. Polysaccharide
- E. Ribonucleic acid

28. The diagram depicts the movement of an amoeba. Which cellular structure is responsible for the amoeba's movement?



- A. Cilia
- B. Flagella
- C. Cell wall
- D. Cytoskeleton
- E. Cell membrane

29. Where do the reactions of the Calvin cycle take place?

- A. Stroma
- B. Cytoplasm
- C. Thylakoid membrane
- D. Mitochondrial matrix
- E. Mitochondrial membrane

30. The net equation for photosynthesis is

- A. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$
- B. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$
- C. $C_6H_{12}O_6 + 6H_2O \rightarrow 6CO_2 + 6O_2H$
- D. $6CO_2 + 6O_2 \rightarrow C_6H_{12}O_6 + 6H_2O$
- E. $6CO_2 + C_6H_{12}O_6 \rightarrow 6O_2 + 6H_2O$

31. A codon on the coding strand of a gene is shown below. Which anticodon sequence will bind to the transcribed codon?

5'-ACT-3'

- A. 3'-ACU-5'
- B. 3'-TGA-5'
- C. 3'-UGA-5'

- D. 5'-ACU-3'
- E. 5'-UGA-3'

32. Which statement describes one difference between hormones and neurotransmitters?

- A. Hormones modify cellular activity.
- B. Hormones are secreted into the bloodstream.
- C. Hormones produce a change in animal behavior.
- D. Hormones attach to receptors on the cell surface.
- E. Hormones are released in response to external stimuli.

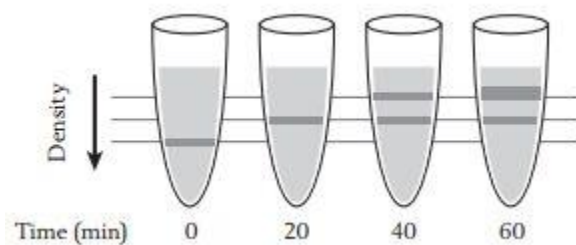
33. The antibiotic tetracycline works by binding to rRNA in prokaryotes. Which cellular activity does tetracycline directly disrupt?

- A. Translation
- B. Respiration
- C. Transcription
- D. DNA replication
- E. Active transport

34. In cellular respiration, the role of FADH_2 and NADH is to

- A. catalyze the breakdown of glucose to three-carbon sugars
- B. carry electrons to the cytochrome membrane proteins
- C. catalyze the addition of a phosphate group to ADP
- D. act as final electron acceptors in the electron transport chain
- E. transport hydrogen ions across the inner mitochondrial membrane

35. Scientists grew *E. coli* bacteria in a nutrient solution containing a heavy, stable isotope of nitrogen, ^{15}N . They then transferred them to a medium with the more common light isotope of nitrogen. Periodically, DNA from the cells was extracted and subjected to density centrifugation. The strain of *E. coli* divides once every 20 minutes. The results are illustrated below.

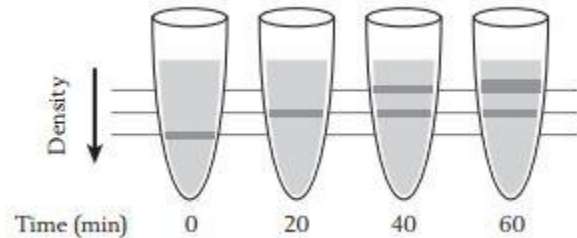


At which time point(s) is the heaviest DNA extracted from the cells?

- A. 0 minutes
- B. 20 minutes
- C. 40 minutes

- D. 60 minutes
- E. 40 and 60 minutes

36. Scientists grew *E. coli* bacteria in a nutrient solution containing a heavy, stable isotope of nitrogen, ^{15}N . They then transferred them to a medium with the more common light isotope of nitrogen. Periodically, DNA from the cells was extracted and subjected to density centrifugation. The strain of *E. coli* divides once every 20 minutes. The results are illustrated below.

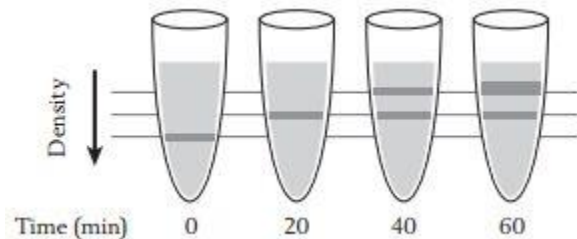


After two cell divisions, what types of chains make up the DNA of the cells?

- I. Two light-nitrogen chains
- II. Two heavy-nitrogen chains
- III. One light-nitrogen chain and one heavy-nitrogen chain

- A. I only
- B. II only
- C. III only
- D. I and II
- E. I and III

37. Scientists grew *E. coli* bacteria in a nutrient solution containing a heavy, stable isotope of nitrogen, ^{15}N . They then transferred them to a medium with the more common light isotope of nitrogen. Periodically, DNA from the cells was extracted and subjected to density centrifugation. The strain of *E. coli* divides once every 20 minutes. The results are illustrated below.



If the scientists were to continue extracting and centrifuging DNA every 20 minutes, which result would describe the DNA bands in the test tubes?

- A. The top band would move lower, while the middle band would disappear.
- B. The top band would grow thinner, while the middle band would grow thicker.
- C. The top and middle bands would both grow thicker and move lower in the tube.
- D. The top and middle bands would both grow thicker but remain at the same level.
- E. The top band would grow thicker, while the middle band would remain the same.

38. Scientists sequenced a portion of the aspartate transaminase enzyme from different species. The amino acid sequences are shown in the table. Each letter stands for an amino acid. Differences from the human sequence are indicated by bold letters. Missing amino acids are indicated by a dash (-).

ORGANISM	AMINO ACID SEQUENCE
Human	P F F D S A Y Q G F A S G N L E R D A W A I R Y F
Horse	P F F D S A Y Q G F A S G N L D R D A W A V R Y F
Rat	P F F D S A Y Q G F A S G D L E K D A W A I R Y F
Pig	P F F D S A Y Q G F A S G N L E K D A W A I R Y F
Chicken	P F F D S A Y Q G F A S G S L D K D A W A V R Y F
Yeast	P F F D S A Y Q G F A T G S L D K D A Y A V R X X
Alfalfa	P F F D S A Y Q G F A S G S L D A D A Q P V R L F
Bacteria	P L F D F A Y Q G F A R G - L E E D A E G L R A F

ORGANISM	AMINO ACID SEQUENCE (CONTINUED)
Human	V S E G F E F F C A Q S F S K N F G L Y
Horse	V S E G F E L F C A Q S F S K N F G L Y
Rat	V S E G F E L F C P Q S F S K N F G L Y
Pig	V S E G F E L F C A Q S F S K N F G L Y
Chicken	V S E G F E L F C A Q S F S K N F G L Y
Yeast	L S T V S P V F V C Q S F S K N A G M Y
Alfalfa	V A D G G E L L V A Q S Y A K N M G L Y
Bacteria	A A M H K E L I V A S S Y S K N F G L Y

Which pair of organisms is most similar in terms of the amino acid sequence shown?

- A. Pig and horse
- B. Chicken and rat
- C. Human and pig
- D. Alfalfa and yeast
- E. Bacteria and yeast

39. Scientists sequenced a portion of the aspartate transaminase enzyme from different species. The amino acid sequences are shown in the table. Each letter stands for an amino acid. Differences from the human sequence are indicated by bold letters. Missing amino acids are indicated by a dash (-).

ORGANISM	AMINO ACID SEQUENCE
Human	P F F D S A Y Q G F A S G N L E R D A W A I R Y F
Horse	P F F D S A Y Q G F A S G N L D R D A W A V R Y F
Rat	P F F D S A Y Q G F A S G D L E K D A W A I R Y F
Pig	P F F D S A Y Q G F A S G N L E K D A W A I R Y F
Chicken	P F F D S A Y Q G F A S G S L D K D A W A V R Y F
Yeast	P F F D S A Y Q G F A T G S L D K D A Y A V R X X
Alfalfa	P F F D S A Y Q G F A S G S L D A D A Q P V R L F
Bacteria	P L F D F A Y Q G F A R G - L E E D A E G L R A F

ORGANISM	AMINO ACID SEQUENCE (CONTINUED)
Human	V S E G F E F F C A Q S F S K N F G L Y
Horse	V S E G F E L F C A Q S F S K N F G L Y
Rat	V S E G F E L F C P Q S F S K N F G L Y
Pig	V S E G F E L F C A Q S F S K N F G L Y
Chicken	V S E G F E L F C A Q S F S K N F G L Y
Yeast	L S T V S P V F V C Q S F S K N A G M Y
Alfalfa	V A D G G E L L V A Q S Y A K N M G L Y
Bacteria	A A M H K E L I V A S S Y S K N F G L Y

All of the following types of mutations could have resulted in the amino acid differences shown EXCEPT

- A. a deletion
- B. an insertion
- C. a missense mutation
- D. a silent mutation
- E. a substitution

40. Scientists sequenced a portion of the aspartate transaminase enzyme from different species. The amino acid sequences are shown in the table. Each letter stands for an amino acid. Differences from the human sequence are indicated by bold letters. Missing amino acids are indicated by a dash (-).

ORGANISM	AMINO ACID SEQUENCE
Human	P F F D S A Y Q G F A S G N L E R D A W A I R Y F
Horse	P F F D S A Y Q G F A S G N L D R D A W A V R Y F
Rat	P F F D S A Y Q G F A S G D L E K D A W A I R Y F
Pig	P F F D S A Y Q G F A S G N L E K D A W A I R Y F
Chicken	P F F D S A Y Q G F A S G S L D K D A W A V R Y F
Yeast	P F F D S A Y Q G F A T G S L D K D A Y A V R X X
Alfalfa	P F F D S A Y Q G F A S G S L D A D A Q P V R L F
Bacteria	P L F D F A Y Q G F A R G - L E E D A E G L R A F

ORGANISM	AMINO ACID SEQUENCE (CONTINUED)
Human	V S E G F E F F C A Q S F S K N F G L Y
Horse	V S E G F E L F C A Q S F S K N F G L Y
Rat	V S E G F E L F C P Q S F S K N F G L Y
Pig	V S E G F E L F C A Q S F S K N F G L Y
Chicken	V S E G F E L F C A Q S F S K N F G L Y
Yeast	L S T V S P V F V C Q S F S K N A G M Y
Alfalfa	V A D G G E L L V A Q S Y A K N M G L Y
Bacteria	A A M H K E L I V A S S Y S K N F G L Y

Which genetic mutation occurred farthest back in time?

- A. Insertion of a codon for serine (S)
- B. Deletion of a codon for asparagine (N)
- C. Conversion of a codon for lysine (K) to one for arginine (R)
- D. Conversion of a codon for alanine (A) to one for cysteine (C)
- E. Conversion of a codon for leucine (L) to one for methionine (M)