SCIENCE TEST

35 Minutes—40 Questions

DIRECTIONS: There are seven passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

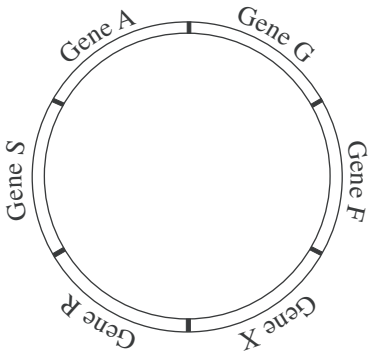
You are NOT permitted to use a calculator on this test.

Passage I

Many bacteria contain *plasmids* (small, circular DNA molecules). Plasmids can be transferred from 1 bacterium to another. For this to occur, the plasmid *replicates* (produces a linear copy of itself). The relative position of the genes is the same on the original plasmid and on the linear copy, except that the 2 ends of the linear copy do not immediately connect.

While replication is occurring, 1 end of the linear copy leaves the donor bacterium and enters the recipient bacterium. Thus, the order in which the genes are replicated is the same as the order in which they are transferred. Unless this process is interrupted, the entire plasmid is transferred, and its 2 ends connect in the recipient bacterium.

Four students studied the way in which 6 genes (F, X, R, S, A, and G) on a specific plasmid were donated by a type of bacterium (see the figure). The students determined that the entire plasmid is transferred in 90 min and that the rate of transfer is constant. They also determined that the genes are evenly spaced around the plasmid, so 1 gene is transferred every 15 min. They disagreed, however, about the order in which the genes are replicated and thus transferred. Four models are presented.



Student 1

Replication always begins between Gene F and Gene X. Gene X is replicated first and Gene F is replicated last.

Student 2

Replication always begins between Gene F and Gene X. However, the direction of replication varies. If Gene F is replicated first, Gene X is replicated last. Conversely, if Gene X is replicated first, Gene F is replicated last.

Student 3

Replication can begin between any 2 genes. Replication then proceeds around the plasmid in a clockwise direction (with respect to the figure). Thus, if Gene S is replicated first, Gene A is replicated second, and Gene R is replicated last.

Student 4

Replication can begin between any 2 genes. Likewise, replication can proceed in either direction. So the order of replication varies.

1. Based on the information presented, if the transfer of the linear copy was interrupted 50 min after transfer began, how many complete genes would have been transferred to the recipient bacterium?

A. 2
B. 3
C. 4
D. 5

2. Based on the model presented by Student 3, if all 6 genes are replicated and the first gene replicated is Gene G, the third gene replicated would be:

F. Gene F.
G. Gene A.
H. Gene S.
J. Gene X.

3. Which students believe that any of the 6 genes on the plasmid can be the first gene transferred to a recipient bacterium?

A. Students 2 and 3
B. Students 2 and 4
C. Students 3 and 4
D. Students 2, 3, and 4

4. Suppose that the model presented by Student 1 is correct and that the transfer of genes between 2 bacteria was interrupted after 45 min. Based on the information provided, which of the following genes would NOT have been transferred from the donor bacterium to the recipient bacterium?

F. Gene G
G. Gene X
H. Gene R
J. Gene S

5. Suppose that Student 2's model is correct and that the transfer of genes between 2 bacteria was interrupted after 30 min. Under these conditions, which of the following genes would definitely NOT be transferred from the donor bacterium to the recipient bacterium?

A. Gene A
B. Gene R
C. Gene G
D. Gene X

6. Suppose that all 6 genes are transferred from a donor bacterium to a recipient bacterium. Under this condition, which student(s) would argue that Gene A could be the last gene transferred?

F. Student 2 only
G. Student 4 only
H. Students 2 and 4 only
J. Students 3 and 4 only

7. Suppose that the transfer of genes between 2 bacteria was interrupted, that the last gene transferred was Gene A, and that no incomplete copies of a gene were transferred. Based on this information, Student 1 would say that transfer was most likely interrupted how many minutes after the transfer began?

A. 15
B. 30
C. 45
D. 60