

**Passage V**

Strains of bacteria carrying a genetic mutation that prevents them from synthesizing the amino acid *histidine* are called *His*<sup>-</sup>. These strains of bacteria must absorb histidine from their environment in order to sustain their growth. Exposing *His*<sup>-</sup> strains of bacteria to *mutagens* (substances that induce DNA mutations) can cause new mutations that restore the ability of some bacteria to synthesize histidine. Any bacterium that regains the ability to synthesize histidine becomes *His*<sup>+</sup> and is known as a *His*<sup>+</sup> revertant.

The number of *His*<sup>+</sup> revertants in a population of bacteria can indicate the potential of a substance to be mutagenic in humans. Scientists tested 4 substances, each suspected to be a mutagen, on a *His*<sup>-</sup> strain of the bacteria *Salmonella typhimurium*.

**Study**

A sterile petri dish (Dish 1) containing a nutrient agar lacking histidine was prepared. Then,  $1 \times 10^8$  cells of *His*<sup>-</sup> *S. typhimurium* were added to Dish 1 and evenly spread over the surface of the nutrient agar. These procedures were repeated for 4 more nutrient agar dishes (Dishes 2–5), except that the bacteria were mixed with 1 of the 4 suspected mutagens before being spread over the surface of the nutrient agar. Table 1 lists, for each of Dishes 2–5, the substance that was mixed with the bacteria before they were added to the dish.

Dish	Substance
2	L
3	M
4	N
5	P

The 5 dishes were incubated at 37°C for 2 days. At the end of the incubation period, the number of colonies growing on the nutrient agar in each dish was determined (see Table 2).

Dish	Number of colonies
1	2
2	14
3	25
4	107
5	6

27. Based on the results of the study, which of the suspected mutagens resulted in the greatest number of *His*<sup>+</sup> revertants in a dish?
- A. Substance L  
 B. Substance M  
 C. Substance N  
 D. Substance P
28. Which dish in the study was intended to serve the purpose of testing whether some of the *S. typhimurium* cells became *His*<sup>+</sup> revertants without the addition of a mutagen?
- F. Dish 1  
 G. Dish 2  
 H. Dish 3  
 J. Dish 4



29. Based on the results of the study, what is the order of the suspected mutagens, from the substance with the *least* potential to be mutagenic to the substance with the *most* potential to be mutagenic?
- A. P, M, N, L  
 B. P, L, M, N  
 C. N, L, P, M  
 D. N, M, L, P

30. In the study, the scientists tested the effect of Substance P at a concentration of  $5 \times 10^{-9}$  g/mL. After the study, the scientists repeated their test of the effect of Substance P, but at 3 other concentrations. The 3 concentrations and their corresponding results are shown in the table below.

Concentration of Substance P	Number of colonies
$10 \times 10^{-9}$ g/mL	14
$50 \times 10^{-9}$ g/mL	54
$100 \times 10^{-9}$ g/mL	114

What is the relationship, if any, between the concentration of Substance P and its potential to cause mutations?

- F. As the concentration of Substance P increases, its potential to cause mutations increases only.  
 G. As the concentration of Substance P increases, its potential to cause mutations decreases only.  
 H. As the concentration of Substance P increases, its potential to cause mutations first decreases and then increases.  
 J. There is no relationship between the concentration of Substance P and its potential to cause mutations.

31. Before bacteria were added to it, the dish that was intended to serve as the control dish in the study lacked which of the substances listed below?

I. Histidine  
 II. Nutrient agar  
 III. Suspected mutagen

- A. II only  
 B. III only  
 C. I and II only  
 D. I and III only
32. Which of the following statements about the numbers of bacteria that regained the ability to synthesize histidine is consistent with the results of the study for Dishes 2 and 3? The number of bacteria that became His<sup>+</sup> revertants after exposure to:
- F. Substance M was about 2 times the number of bacteria that became His<sup>+</sup> revertants after exposure to Substance L.  
 G. Substance L was about 2 times the number of bacteria that became His<sup>+</sup> revertants after exposure to Substance M.  
 H. Substance M was about 4 times the number of bacteria that became His<sup>+</sup> revertants after exposure to Substance L.  
 J. Substance L was about 4 times the number of bacteria that became His<sup>+</sup> revertants after exposure to Substance M.
33. The particular strain of *S. typhimurium* chosen for the study lacks normal DNA repair mechanisms. Which of the following statements gives the most likely reason this particular strain was chosen? The scientists:
- A. did not want the bacteria in the study to synthesize any DNA.  
 B. did not want the bacteria in the study to synthesize any proteins.  
 C. wanted the bacteria in the study to be able to repair the mutations caused by the substances.  
 D. wanted the bacteria in the study to be unable to repair the mutations caused by the substances.