

PASSAGE III

A scientist tested the ability of 5 newly engineered drugs to kill penicillin-resistant bacteria.

Experiment 1

Equal numbers of penicillin-resistant bacteria were put into flasks containing 10.0 milliliters of a nutrient medium. The flasks were incubated for 1 hour at 37°C with different concentrations of the 5 drugs shown in Table 1. A control consisted of bacteria incubated in the medium without any drugs. The bacteria were washed to remove residual drug traces and grown on nutrient agar plates for 7 days. During this time, the bacteria reproduced, forming colonies, which were then counted at the end of the seventh day. Plates with more colonies were assumed to have more live bacteria at the end of the 1-hour incubation period. Table 1 shows the number of colonies counted. The drug-free control showed 50 colonies at the end of 7 days.

Drug	Drug concentration (mM)			
	5	10	15	25
Number of colonies:				
R	41	26	9	0
S	42	29	12	2
T	45	35	20	5
U	47	38	21	6
V	50	40	22	7

Notes: *mM is micromolar
Numbers of colonies are averages

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Experiment 2

Bacteria were handled as described in Experiment 1 with two exceptions: all drugs were tested at the same concentration and the incubation time of each culture was varied. Table 2 shows the number of colonies counted for Experiment 2.

Drug	Incubation time (h)			
	1	6	12	24
Number of colonies:				
R	22	8	2	0
S	39	12	4	1
T	40	15	6	2
U	41	18	7	3
V	45	22	9	5
None	50	50	50	50

Note: Numbers of colonies are averages for 7 replicates (identical samples).

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Experiment 3

Permeability coefficients measure a drug's ability to break through the cell membrane of a bacterium. The larger the permeability coefficient, the faster the drug is able to transfer through the membrane. The molecular mass, in atomic mass units (amu), and permeability coefficient, in centimeters per second (cm/s) of the 5 drugs at 37°C were measured. The results are shown in Table 3.

Drug	Molecular mass (amu)	Permeability coefficient (cm)
R	455	10^{-7}
S	470	10^{-8}
T	485	10^{-5}
U	500	10^{-10}
V	515	10^{-11}

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13. Based on Experiment 1, at a concentration of 10 mM, which drug was most effective at killing bacteria?

- A. Drug R
- B. Drug S
- C. Drug T
- D. Drug V

14. Based on the results of Experiment 3, which drug enters bacteria cells most quickly?

- F. Drug R
- G. Drug S
- H. Drug T
- J. Drug V

15. If Experiment 2 were repeated with Drug U and an incubation time of 3 hours, the number of colonies counted would most likely be:

- A. more than 50.
- B. between 41 and 50.
- C. between 18 and 41.
- D. fewer than 18.

16. Which of the following statements best describes the relationship between the molecular mass and the permeability coefficient of the drugs, as shown in Experiment 3?

- F. As the molecular mass decreases, the permeability coefficient increases.
- G. As the molecular mass increases, the permeability coefficient increases.
- H. As the molecular mass decreases, the permeability coefficient remains constant.
- J. As the molecular mass increases, the permeability coefficient remains constant.

17. Which of the following statements best describes the relationship between incubation time and number of live bacteria in Experiment 2?

- A. As incubation time increases, the number of live bacteria increases only.
- B. As incubation time increases, the number of live bacteria decreases only.
- C. As incubation time increases, the number of live bacteria quickly increases, then slowly decreases.
- D. As incubation time increases, the number of live bacteria quickly decreases, then slowly increase.

18. In Experiment 1, what was the relationship between drug concentration and the drug's effectiveness in killing penicillin-resistant bacteria?

- F. Based on Experiment 1, there is no relationship between drug concentration and drug effectiveness.
- G. Some of the drugs were most effective at the lowest concentration used while others were most effective at the highest concentration used.
- H. All 5 drugs were most effective at the highest concentration used.
- J. All 5 drugs were most effective at the lowest concentration used.

19. The experimental procedures used in Experiment 1 and 2 differed in that in Experiment 1:

- A. incubation time was held constant, while drug concentration was varied.
- B. incubation time was varied, while drug concentration was held constant.
- C. incubation time and drug concentration were both held constant.
- D. incubation time and drug concentration were both varied.