

Solutions

2.1

- Bacteria synthesise folate; humans import it in the diet – the pathway is the difference ✓.

2.2

- $10^9 \times 10^{-8} = 10^1 \approx 10$ mutants ✓.

2.3

- β -lactamase hydrolyses (opens) the drug ring; PBP2a is an altered target that still builds the wall ✓.

3.1

- $4 \times 10^9 \times 10^{-8} = 40$ resistant mutants expected ✓.
- Double mutant: $10^{-8} \times 10^{-8} = 10^{-16}$ per cell pair ✓.
- $4 \times 10^9 \times 10^{-16} = 4 \times 10^{-7}$ – effectively zero in the culture ✓.
- Combinations exist because two independent probabilities multiply: the resistant fraction collapses ✓.

3.2

- Every large population already carries the resistant fraction (10^{-7} – 10^{-9} per cell per generation) ✓.
- The drug SELECTS it: sensitive cells die, resistant cells fill the niche; plasmids then move genes between species ✓.
- Narrowing to the reported susceptibility removes needless pressure on the rest of the ward flora – stewardship is the mechanism applied ✓.