

4. What are “jumping genes,” and what role do they play in the evolution of bacteria?
5. Explain the clinical significance of using antibiotics as a food supplement in animal feeds.

ANSWERS

Matching

- I. 1. f 2. b 3. d 4. c 5. a 6. e
- II. 1. c 2. d 3. a 4. b 5. e
- III. 1. a 2. a 3. b 4. d 5. e 6. f
- IV. 1. f 2. b 3. e 4. d
- V. 1. b 2. a 3. a 4. a 5. a
- VI. 1. a 2. b
- VII. 1. b 2. d 3. c 4. a
- VIII. 1. a 2. b 3. e 4. c 5. d

Fill in the Blanks

1. replica plating 2. gene 3. replication fork 4. genotype 5. competent 6. Hfr 7. constitutive
8. resistance transfer factor 9. phage

Critical Thinking

1. When conditions are optimal—for example, in log phase—bacterial cells can initiate multiple replication forks on the origin of the chromosome. A new pair begins before the original pair finishes.
2. Base substitutions, also called point mutations, are common mutations in which a single base of a DNA molecule is replaced with a different base. Because of the redundancy in the genetic code, this may not cause a problem, or it may result in a missense or a nonsense mutation.

Frameshift mutations involve the insertion or deletion of one or more nucleotide pairs and can shift the reading frame (the three-by-three groupings) of nucleotides. This usually results in a long stretch of missense and production of a nonfunctional protein. Translation is likely to be terminated when a nonsense codon is encountered.

3. Ionizing radiation, such as X rays and gamma rays, penetrate well and have high energy contents. They ionize molecules, making them very reactive. Some of the affected ions combine with bases in DNA, resulting in replication errors. Ionizing radiation may even cause breakage of the covalent bonds in the sugar-phosphate backbone of DNA, resulting in physical breaks in the chromosome. Bacteria do not possess a mechanism to repair this very serious damage.

Nonionizing radiation such as UV light does not carry as much energy or penetrate as effectively. UV light will, however, cause thymine dimers to form in the DNA strand. If the dimers are not repaired, then proper transcription and replication of DNA cannot occur.

Bacteria (and other organisms) have photoreactivating enzymes that can repair damage caused by UV light by splitting the dimers. Occasionally this repair process will result in errors and is yet another source of mutation.

4. Jumping genes, or transposons, are small segments of DNA that can move from one region of a DNA molecule to another, to another DNA molecule, or to a plasmid. This is not a common occurrence. They may contain genes that allow bacteria to resist toxins or antibiotics. Because transposons can be carried between cells and even species via viruses or plasmids, they can play a significant role in evolution.
5. Some bacterial cells have a type of plasmid referred to as an R factor. R factors carry genes that provide resistance to one or more antibiotics and can be passed from cell to cell and even to other species through the process of conjugation. When antibiotics are used as a supplement in animal feeds, bacteria able to resist these drugs are selected by preferentially diluting the effectiveness of antibiotics.