

## Microbial Genetics, Mutation and Repair

### Answer the following questions

1. Define genetic recombination.
2. State the function of Rec A proteins in homologous genetic recombination.
3. List 3 types of bacterial genetic recombination seen in nature.
4. Briefly describe the mechanisms for transformation in bacteria.
5. A strain of living *Streptococcus pneumoniae* which cannot make a capsule is injected into mice and has no adverse effect. This strain is then mixed with a culture of heat-killed *Streptococcus pneumoniae* which when alive was able to make a capsule and kill mice. After a period of time, this mixture is injected into mice and kills them. In terms of genetic recombination, describe what might account for this.
6. Briefly describe the following mechanisms of genetic recombination in bacteria:
  - a. generalized transduction
  - b. specialized transduction
7. Briefly describe the following mechanisms of genetic recombination in bacteria:
  - a. F<sup>+</sup> conjugation
  - b. Hfr conjugation
8. Describe R-plasmids, R-plasmid conjugation, and the significance of R-plasmids to medical microbiology.

### FILL IN THE BLANKS:

1. A technique in which electricity is used to make cells competent is \_\_\_\_\_.
2. Naked DNA can be taken up into cells via the process of \_\_\_\_\_.
3. \_\_\_\_\_ occurs when a virus moves DNA from one cell to another.
4. A virus which infects bacterial cells is known as a \_\_\_\_\_.
5. A \_\_\_\_\_ bacteriophage cycle results in the rupture of the host cell.
6. Persistence of a prophage in the DNA of a cell without prophage replication or lysis of the bacterial cell is known as \_\_\_\_\_.
7. Genetic information transferred from one bacteria to another using a pilus is known as \_\_\_\_\_.
8. F<sup>+</sup> cells contain a fertility \_\_\_\_\_.
9. An \_\_\_\_\_ plasmid contains both the genetic information needed for a sex pilus as well as parts of the bacterial chromosome.
10. Plasmids that can transfer between two different bacterial species are said to be \_\_\_\_\_.
11. In \_\_\_\_\_ transduction, only genes near the prophage are transferred to another bacterium.
12. \_\_\_\_\_ plasmids give a cell the ability to survive in the presence of certain antibiotics.
13. Bacteriocidal proteins called \_\_\_\_\_ are produced by some bacterial plasmids.

14. Mobile genetic elements called \_\_\_\_\_ were first found in the 1940s by Barbara McClintock.
15. Increasing the number of plasmids in a cell so that more product is produced is a technique known as gene \_\_\_\_\_.
16. \_\_\_\_\_ enzymes are used to cut DNA at specific sites.
17. Joining two pieces of DNA together requires the use of the enzyme \_\_\_\_\_ to reunite the ends of the two DNA fragments.

**BRIEF ANSWERS AND / OR ESSAY TYPE QUESTIONS:**

1. Explain why an E. coli strain that is His- is an auxotroph and one that is Lac- is not. (Hint: Think about what E. coli does with histidine and Lactose)
2. Explain why the insertion of a transposon leads to a mutation
3. What are silent mutations and why do they occur? From the knowledge of the genetic code, why do you think most silent mutations affect the third position of the codons?
4. Give an example of one biological, one chemical and one physical mutation and describe the mechanisms by which each causes a mutation.
5. Describe the different mechanisms by which DNA mutations is repaired in a cell.
6. DNA is transferred in the microbial world by three mechanisms. Describe these.
7. Describe how you would isolate a mutant that require histidine for growth and was resistant to penicillin.
8. Sometimes a point mutation does not change the phenotype. List all the reasons you can why this is so.

**MCQ – Structure and Function Module**

Question:

The \_\_\_\_\_ do not possess a nuclear membrane

ans:

algae

ans:

bacteria

ans:

eucaryotes

ans:

fungi

ans:

protozoa.

Question:

Which of the following components of various pathogenic microbes does not play a role in the attachment of pathogens to surfaces of the body?

ans:

fimbriae

ans:

flagella

ans:

Question:

Mycolic acids are characteristically found in the cell walls of:

ans:

Bacillus

ans:

mycobacterium

ans:

mycoplasma

ans:

streptococcus

ans:

treponema

Question:

A major distinguishing characteristic of archaeal phospholipids in the presence of

ans:

ester linkages

ans:

ether linkages

ans:

hydrophobic fatty acid

ans:

polar head groups

ans:

sterols.

Question:

The molecules that link the repeating units of peptidoglycan chains are

ans:

carbohydrates

ans:

fatty acids

ans:

peptides

ans:

proteins

ans:

short-chain polysaccharides.

Question:

The toxic portion of the outer membrane of the gram-negative wall is

ans:

glycolipid

ans:

phospholipid

ans:

porin proteins

ans:

teichoic acid

ans:

the lipid A of the lipopolysaccharide

Question:

\_\_\_\_\_ are associated with genetic exchange in bacteria.

ans:

capsules

ans:

endospores

ans:

fimbriae

ans:

flagella

ans:

pili

Question:

Functionally the periplasmic space of bacteria is analogous to the \_\_\_\_\_  
of eucaryotic cells

ans:

centrioles

ans:

endoplasmic reticulum

ans:

golgi bodies

ans:

lysosomes

ans:

mitochondria.

Question:

Bacterial fimbriae and pili function primarily in

ans:

attachment

ans:

motility

ans:

nutrient uptake

ans:

protection against cell lysis

ans:

protection against phagocytosis.

Question:

An example of extrachromosomal DNA is the

ans:

basal body

ans:

capsule

ans:

mesosome

ans:

nucleoid

ans:

plasmid.

Question:

The DNA of the endospore is found in the

ans:

core

ans:

cortex

ans:

dipicolinic acid

ans:

spore appendages

ans:

spore coat or exosporium.

Question:

The bacterial cytoplasmic membrane is not

ans:

a site of protein synthesis

ans:

a site of respiratory enzymes

ans:

composed of lipoprotein

ans:

necessary for cell survival

ans:

responsible for semi-permeability.

Question:

Which of the following is found in eukaryotic organisms and not in prokaryotic organisms?

ans:

mitochondrion

ans:

photosynthetic pigments

ans:

DNA

ans:

ribosomes.

Question:

Which of the following would be cell wall-less prokaryotes?

ans:

bacteria, archaeobacteria, and chlamidia

ans:

protoplasts, L-forms, and mycoplasma

ans:

sporeforming bacteria, archaeobacteria

ans:

bacteria.

Question:

Which of the following would be most resistant to heat?

ans:

Clostridium botulinum vegetative cells

ans:

Bacillus anthracis forespore

ans:

Clostridium histolyticum endospore

ans:

Methanobacterium thermoautotrophicum cells.

Question:

High concentration of dipicolinic acid is unique to what bacterial structure?

ans:

DNA of nucleoid

ans:

RNA of ribosomes

ans:

cortex of endospore

ans:

peptidoglycan of cell wall.