

Part 1

1. Which of the following mutagens is most likely to cause a frameshift mutation?
 - a) Base analog
 - b) Alkylating agent
 - c) Intercalating agent
 - d) Ionizing radiation
 - e) UV light

2. What is the plasmid status of bacterial cells resulting from conjugation between a F⁺ and a F bacterium?
 - a) Two F⁺ bacteria
 - b) Two F bacteria
 - c) The F⁺ bacterium becomes F, and the F bacterium becomes F⁺.
 - d) The F⁺ bacterium remain as F⁺, and the F bacterium remain as F.

3. The Ti plasmid is found in
 - (a) Agrobacterium
 - (b) Yeast as a 2mm plasmid
 - (c) Rhizobium of the roots of leguminous plants
 - (d) Azotobacter
4. Which of the following is true for a plasmid?
 - a) Contains an origin of replication
 - b) Imparts a useful characteristic to the host bacterium
 - c) Possesses one or more genes
 - d) Replicates only when the host genome is undergoing replication

5. What is the function of DNA polymerase III?
 - a) to seal together the broken ends of DNA strands
 - b) to degrade damaged DNA molecules
 - c) to add nucleotides to the 3' end of a growing DNA strand
 - d) to re-join the two DNA strands (one new and one old) after replication
 - e) to unwind the DNA helix during replication

6. Approximately what percentage of the nucleotides in this sample will be thymine?
 - a) 8%
 - b) 16%
 - c) 31%
 - d) 42%

7. Which enzyme catalyses the elongation of a DNA strand in the 5' → 3' direction?
 - a) DNA polymerase III
 - b) primase
 - c) topoisomerase

- d) helicase
- e) DNA ligase

8. What process repairs damage to a pre-existing double helix?

- a) transformation
- b) mismatch repair
- c) operon repair
- d) nucleotide excision repair
- e) proofreading

9. What is the role of DNA ligase in the elongation of the lagging strand during DNA replication?

- a) It catalyses the lengthening of telomeres.
- b) It joins Okazaki fragments together.
- c) It unwinds the parental double helix.
- d) It synthesizes RNA nucleotides to make a primer.
- e) It stabilizes the unwound parental DNA

10. Which of the following enzymes synthesizes short segments of RNA?

- a) helicase
- b) DNA polymerase III
- c) ligase
- d) DNA polymerase I
- e) Primase

11. In DNA from any species, the amount of adenine equals the amount of thymine, and the

amount of guanine equals the amount of cytosine. Which of the following investigators was (were) responsible for this discovery?

- a) Frederick Griffith
- b) Matthew Meselson and Franklin Stahl
- c) Oswald Avery
- d) Erwin Chargaff
- e) Alfred Hershey and Martha Chase

12. In nucleotide excision repair, damaged DNA is excised by what enzyme(s)?

- a) ligase
- b) helicase
- c) primase
- d) nuclease
- e) DNA polymerases

13. During DNA replication, which of the following enzymes removes the RNA nucleotides from

the primer and adds equivalent DNA nucleotides to the 3' end of Okazaki fragments?

- a) helicase
- b) DNA polymerase III
- c) ligase
- d) DNA polymerase I
- e) Primase

14. Griffith's experiments with *S. pneumoniae* were significant because they showed that traits

could be transferred from one organism to another. What else did he find that was significant?

DNA was the genetic material.

- a) A virus made the bacteria pathogenic.
- b) Heat kills bacteria.
- c) The transferred traits were heritable.
- d) Protein could not be the genetic material.

15. Who conducted the X-ray diffraction studies that were key to the discovery of the structure of

DNA?

- a) Chargaff
- b) Griffith
- c) Meselson and Stahl
- d) Franklin
- e) McClintock

16. A space probe returns with a culture of a microorganism found on a distant planet. Analysis

shows that it is a carbon-based life-form that has DNA. You grow the cells in ^{15}N medium for several generations and then transfer them to ^{14}N medium. Which pattern in the figure would

you expect after one round of DNA replication if the DNA was replicated in a conservative manner?

- a) A
- b) B

- c) C
- d) D
- e) E

17. Which of the following help(s) to hold the DNA strands apart while they are being replicated?

single-strand binding proteins

- a) ligase
- b) DNA polymerase
- c) nuclease
- d) primase

What is the function of helicase in DNA replication?

- a) It relieves strain from twisting of the double helix as it is unwound.
- b) It joins together Okazaki fragments.
- c) It adds nucleotides to the new strand in the 5' to 3' direction.
- d) It untwists the double helix and separates the two DNA strands.
- e) It checks for errors in the newly synthesized DNA strand.

18. During DNA replication, which of the following enzymes separates the DNA strands during

replication?

- a) helicase
- b) DNA polymerase III
- c) ligase
- d) DNA polymerase I
- e) primase

19. What are chromosomes made of?

- a) DNA, heterochromatin, and histone proteins
- b) DNA, RNA, and proteins
- c) DNA and proteins
- d) DNA
- e) DNA and euchromatin

20. During DNA replication, which of the following enzymes covalently connects segments of

DNA?

- a) helicase
- b) DNA polymerase III
- c) ligase

- d) DNA polymerase I
- e) Primase

21. In the late 1950s, Meselson and Stahl grew bacteria in a medium containing "heavy" nitrogen

(^{15}N) and then transferred them to a medium containing ^{14}N . Which of the results in the figure

would be expected after one round of DNA replication in the presence of ^{14}N ?

- a) A
- b) B
- c) C
- d) D
- e) E

22. What is the function of topoisomerase?

- a) adding methyl groups to bases of DNA
- b) stabilizing single-stranded DNA at the replication fork
- c) unwinding of the double helix
- d) relieving strain in the DNA ahead of the replication fork
- e) elongating new DNA at a replication fork by adding nucleotides to the existing chain

23. How is transformation in bacteria most accurately described?

- a) the infection of cells by a phage DNA molecule
- b) the type of semiconservative replication shown by DNA
- c) the creation of a strand of RNA from a DNA molecule
- d) assimilation of external DNA into a cell
- e) the creation of a strand of DNA from an RNA molecule

24. The leading and the lagging strands of DNA formed during DNA replication differ in that

the lagging strand is synthesized continuously, whereas the leading strand is synthesized in short

fragments that are ultimately stitched together.

- a) the leading strand is synthesized in the same direction as the movement of the replication fork,
- b) and the lagging strand is synthesized in the opposite direction.
- c) the leading strand is synthesized at twice the rate of the lagging strand.
- d) the leading strand is synthesized by adding nucleotides to the 3' end of the growing strand, and
- e) the lagging strand is synthesized by adding nucleotides to the 5' end.

25. What are the repetitive DNA sequences present at the ends of eukaryotic chromosomes

called?

- a) telomeres
- b) chromomeres
- c) sarcomeres
- d) centromeres
- e) polypeptides

26. It became apparent to Watson and Crick after completion of their model that the DNA molecule could carry a vast amount of hereditary information based on which of the following characteristics?

- a) complementary pairing of bases
- b) the sequence of bases
- c) phosphate-sugar backbones
- d) different five-carbon sugars

Which of the following gene helps in identifying transformed cells?

- (a) plasmid
- (b) selectable marker
- (c) structural gene
- (d) vector

Part 2

1. What are the possible ways through which a plasmid can replicate?
 - a) Using cell's own replicative enzymes
 - b) Carry genes that code for special replicative enzymes
 - c) Replicate by inserting themselves into a bacterial chromosome
 - d) Carry genes that codes enzymes
2. Which of the following is not a type of plasmid?
 - a) F
 - b) R
 - c) Ti
 - d) T4
3. 9. Which characteristics do F-plasmids confer to the host bacterium?
 - a) Antibiotic resistance
 - b) Fluorescent colonies
 - c) Conjugative ability

- d) Virulence
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- 4. Col plasmids are responsible for _____
 - a) Degrading unusual molecules
 - b) Taking up colchicine stain
 - c) Coding for colicins
 - d) None
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- 5. 12. Ti plasmids are _____ plasmids.
 - a) Tumour inducing
 - b) Degradation
 - c) High copy number
 - d) Mammalian
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- 6. Protection by covalent attachment of proteins in a plasmid, is a method for?
 - a) increasing the conjugative abilities
 - b) protection of linear DNA
 - c) increasing the copy number
 - d) increasing cloning efficiency
-
- 7. Plasmids are often targets for antibiotics. True or false?
 - e) True
 - f) False
-
- 8. Which of the following describes the majority of bacterial genomes?
 - a) single stranded and linear
 - b) single stranded and circular
 - c) double stranded and linear
 - d) double stranded and circular
-
- 9. A virus with an RNA genome must encode an RNA-dependent RNA polymerase.
True or false?
 - g) True
 - h) False
-
- 10. What information can be determined from interrupted mating of bacteria?
 - i) DNA nucleotide sequence
 - j) chromosomal positions of bacterial genes
 - k) plasmid homology
 - l) bacterial recombination rates

11. Which replication cycle is required for cloning with phage?

- a) Lysogenic cycle
- b) Lytic cycle

12. The bacterial genome differs from the eukaryotic genome in that:

- a) The genetic material is RNA rather than DNA
- b) It contains a single chromosome
- c) It contains several genes

13. Which of these statements is true?

- a) Plasmids are usually found naturally in prokaryotes but can be found in some eukaryotes
- b) Plasmids are naturally only found in bacteria
- c) Plasmids are found extensively in all organisms

14. what enzyme unwinds the DNA strand during DNA Replication

- a) DNA Polymerase III
- b) DNA Polymerase I
- c) Helicase

15. The development of virulent, toxin-producing bacterial strains due to the presence of a

temperate phage can occur in:

- a) bacterial conjugation
- b) transformation
- c) translation
- d) transduction

16. Spontaneous mutations could arise from _____.

- a) DNA replication errors
- b) atmospheric radiation
- c) addition of insertion sequences
- d) All of the above

17. In bacteria a group of genes located together and functioning together on a chromosome

are called _____.

- a) polysome
- b) operon
- c) polymerase
- d) exons

18. What is the process called of making a mRNA copy of DNA?

- a) translation.

- b) transcription.
- c) transposon
- d) transformation

19. Length of DNA containing genes. The cells intracellular source of genetic information

- a) transposon
- b) polysomes
- c) regulatory gene
- d) chromosome

20. At a chromosome replication fork, the lagging strand consists of _____ that are joined by _____.

- a) RNA sequences ; DNA ligase
- b) Okazaki fragments ; RNA polymérase
- c) RNA sequences ; ribosomes
- d) Okazaki fragments ; DNA ligase

21. DNA compaction involves _____.

- a) a twisting and packing of the DNA
- b) Supercoiling
- c) The formation of looped domains
- d) All of the above

22. Why is DNA replication considered semiconservative?

- a) none of the materials are wasted
- b) it is a very efficient process
- c) half of the new DNA molecule is half of the original molecule
- d) none of the above are correct

23. Which one of the following statements is not true of RNA?

- a) RNA contains the monosaccharide ribose.
- b) RNA is primarily a single-stranded molecule.
- c) RNA has a sugar-phosphate backbone.
- d) RNA contains five different nucleotides.

24. In a eukaryotic microbe, those sections of a primary RNA transcript that will NOT be translated are called _____.

- a) introns
- b) anticodons
- c) "Jumping genes"
- d) Exons

25. Which one of the following statements is NOT true of the bacterial chromosome?

- a) It is located in the nucleoid
- b) It usually is a singular circular molecule
- c) Some genes are dominant to others
- d) It usually is haploid

26. The enzyme _____ adds complementary bases to the DNA template strand during replication.

- a) ligase
- b) helicase
- c) DNA polymerase III
- d) RNA polymerase

27. Which of the following are examples of mutagens?

- a) detergent
- b) UV light
- c) fertilizer
- d) none of the above are correct

28. In the semiconservative method of replication

- a) both parent strands are degraded.
- b) one parent strand is conserved in each of the statements new DNA.
- c) both parent strands reform with one another.
- d) Okazaki fragments form both of the new molecules of DNA.

29. Plasmids are _____.

- a) another name for transposons
- b) accessory genetic information
- c) domains within a chromosome
- d) daughter chromosomes

30. Nucleotide excision repair would correct DNA damage caused by _____.

- a) antibiotics
- b) UV light
- c) transcription
- d) a DNA replication error

31. The duplication of a cell's DNA is called

- a) Helicase
- b) transcription.
- c) UV light
- d) Replication

Part 3

1. Which of the two mutation happens more often:
 - a) Spontaneous Mutation
 - b) Mutations caused by Mutagens

2. The translation of a mRNA by multiple ribosomes is called _____ formation.
 - a) Okazaki
 - b) polysome
 - c) plasmid
 - d) transposon

3. Which of the following codons would terminate translation?
 - a) AUG
 - b) UUU
 - c) UAA
 - d) UGG

4. DNA replication is semiconservative because the _____ strand will become half of the _____ molecule.
 - a) RNA, DNA
 - b) template, finished
 - c) sense, mRNA
 - d) codon, anticodon

5. In DNA, adenine is the complementary base for _____ and cytosine is the complement for _____.
 - a) guanine, thymine
 - b) uracil, guanine
 - c) thymine, guanine
 - d) thymine, uracil

6. The base pairs are held together primarily by
 - a) covalent bonds
 - b) hydrogen bonds
 - c) ionic bonds
 - d) gyrase
7. For mutations to have an effect on population of microbes, they must be
 - a. inheritable
 - b. permanent
 - c. beneficial

- d. a and b
 - e. all of the above
8. The nitrogen bases in DNA are bonded to the...
- a) phosphate
 - b) deoxyribose
 - c) ribose
 - d) hydrogen
9. As a general rule, the template strand on DNA will always begin with
- a) TAC
 - b) AUG
 - c) ATG
 - d) UAC
10. Why must the lagging strand of DNA be replicated in short pieces?
- a) because of limited space
 - b) otherwise, the helix will become distorted
 - c) the DNA polymerase can synthesize in only one direction
 - d) to make proofreading of code easier
11. Which if the following is present in prokaryotes but not eukaryotes?
- a) exons
 - b) polyribosomes
 - c) spliceosomes
 - d) simultaneous transcription & translation
12. A nucleotide contains which of the following?
- a) 5-carbon sugar
 - b) nitrogen base
 - c) phosphate
 - d) b and c only
 - e) all of these
13. Which of the following characteristics is not true of a plasmid?
- a) It is a circular piece of DNA
 - b) It is required for normal cell function
 - c) It is found in bacteria
 - d) It can be transferred from cell to cell
14. Which of the following statements about an animal bearing a somatic mutation is TRUE?

Some, but not all, of the animal's offspring will also carry the mutation.

- a) All of the animal's offspring will carry the mutation.
- b) Both the animal and its offspring will show the mutant trait.
- c) The animal but not its offspring can be affected by the mutation.
- d) The gametes produced by the animal will all carry the mutation.

15. Helen has type I osteogenesis imperfecta (OI), a genetic skeletal disorder. Shown below is

her DNA sequence for a portion of the coding region of the collagen type I gene, which contains the mutation responsible for her disorder. The corresponding wild-type sequence is shown also (only one DNA strand is shown in each case).

Helen 5-AAACTCCACTTCTTCCAGTAC-3

Normal 5-AAACTCACTTCTTCCAGTAC-3

16. What type of mutation does Helen carry?

- a) Missense
- b) Nonsense
- c) Silent
- d) Deletion
- e) Frameshift

17. Which of the following DNA repair systems does not involve the activity of a DNA polymerase?

- a) Mismatch repair in humans
- b) Nucleotide-excision repair in yeast
- c) Photoreactivation in *E. coli*
- d) Base-excision repair in *E. coli*
- e) All of the above in the activity of a DNA polymerase

18. 8. Fragile-X syndrome is an example of a disease caused by what type of mutation?

- a) Nonsense mutation
- b) Frameshift mutation
- c) Expanding nucleotide repeat
- d) Loss-of-function
- e) Gain-of-function

19. Strains of *E. coli* that are defective in mismatch repair have very high levels of spontaneous

mutagenesis. Studies have shown that in wild-type strains A:C and G: T mispairings (as opposed

to the normal A: T and G:C pairings) that occur during DNA replication are more likely than

other mispairings (A: G, etc.) to be detected and repaired in these mismatches repair-proficient,

wild-type strains. Which of the following types of base substitutions would you expect to be most common among the spectrum of spontaneous mutations created by the mutant mismatch repair-defective strains?

- a) A-to-C
- b) C-to-A
- c) G-to-C
- d) A-to-G
- e) A-to-T

20. An example of a genetic disorder in humans that results from a loss-of-function mutation is

- a) cystic fibrosis.
- b) achondroplasia.
- c) Huntington disease.
- d) myotonic dystrophy.
- e) None of the above is correct.

21. A _____ mutation changes a codon that specifies an amino acid into one that terminates

- a) translation.
- b) missense
- c) nonsense
- d) silent
- e) neutral

22. The type of mutation that reverses the effects of a frameshift mutation without changing the

frameshift and occurs with the same gene as the frameshift are called a(n)

- a) intergenic suppressor mutation
- b) nonsense mutation
- c) missense mutation
- d) intragenic suppressor mutation
- e) silent mutation

23. Insertion or removal of one or more nucleotide base pairs in DNA within a gene often results in a _____ mutation.

- a) transition
- b) frameshift
- c) reversion

- d) transversion
 - e) suppressor
24. What is the consequence of a transversion mutation in duplex DNA?
- a) A purine is replaced by a pyrimidine, and a pyrimidine is replaced by a purine.
 - b) A base pair is lost within the DNA of a gene, which causes a reading frame shift.
 - c) A purine is replaced by another purine, and a pyrimidine is replaced by another pyrimidine.
 - d) A base pair is added to the DNA within a gene, which causes a reading frame shift.
 - e) The sequence of the DNA remains the same since the change involves proteins.

Part 4

1. What do alkylating agents do?
- a) They cause pyrimidine dimers.
 - b) They add methyl or ethyl groups to bases.
 - c) They oxidize guanine.
 - d) They deaminate cytosine.
 - e) They can do all of the above.

2. Suppose a research study shows that people who suffer from severe depression are homozygous for a mutation in the hypothetical DEP gene. Individuals without this form of depression have the following sequence at the beginning of the translated region of their DEP

genes 5-ATG ACG TTT GAA ATT CAG TCT AGA-3 (Met Thr Phe Glu Ile Gln Ser Arg).
Affected

individuals have the following sequence 5-ATG ACG TTT GAA ATT TAG TCT AGA-3 (Met Thr

Phe Glu Ile STOP). The mutation identified is most likely a

- a) missense.
- b) gain of function.
- c) nonsense.
- d) frameshift.
- e) deletion.

3. Which of the following correctly describes nonsense mutations?
- a) They cause a non-functional amino acid to replace a functional amino acid.
 - b) They change the nucleotide sequence of a gene but do not change the sequence of the resulting
 - c) protein.
 - d) They result in the insertion or deletion of a small number of nucleotides to the DNA.
 - e) They convert a codon for a particular amino acid within a gene into a stop codon.
 - f) They cannot revert or back mutate to wild-type.

4. Assume that you have discovered a new chemical mutagen that modifies guanine so that is

mis pairs with adenine when adenine is in the template DNA strand during DNA replication.

However, this mispairing is limited to when the modified guanine is being added to the newly replicating DNA strand. When the modified guanine is in the template DNA strand it always pairs normally with cytosine being added to the growing newly synthesized strand. What type

of mutation would you predict would be caused by the new chemical mutagen?

- a) A-to-G base substitutions
- b) A-to-C base substitutions
- c) A-to-T base substitutions
- d) A-to-G and A-to-C base substitutions
- e) G-to-T base substitutions

5. A new IS element is found in bacteria. Which of the following pairs of DNA sequences would most likely be found at each end of the IS element? (Only one of the two DNA strands is given.)

- a) 5'-GAGACTCTAC-3' and 5'-GAGACTCTAC-3'
- b) 5'-GAGACTCTAC-3' and 5'-CATCTCAGAG-3'
- c) 5'-GAGACTCTAC-3' and 5'-CTCTGAGATG-3'
- d) 5'-GAGACTCTAC-3' and 5'-GTAGAGTCTC-3'
- e) 5'-GAGACTCTAC-3' and 5'-CAGACTCTAG-3'

6. Which of the following kinds of mutations is most likely to be null loss-of-function?

- a) Transition
- b) Transversion
- c) Frameshift
- d) Missense
- e) Induced

7. Hybrid dysgenesis in *Drosophila* occurs

- a) when a male and a female, each carrying a copier element, mate and produce offspring that have numerous mutations.
- b) in the offspring of a cross between a male that carries a copier element and a female that carries a P element.
- c) in the offspring of a cross between a male that carries a Ty element and a female that carries an Ac element.
- d) in the offspring of a cross between a male that carries a P element and a female that does not carry a P element.
- e) in the offspring of a cross between a male that carries a Alu element and a female that carries a Ty element.

8. Bacterial insertion sequences encode which of the following gene products?

- a) Reverse transcriptase
- b) DNA polymérase
- c) Transposase
- d) Repressor
- e) Invertase

9. A mutation that changes a GC base pair to AT is a(n)

- a) transition.
- b) transversion.
- c) induced mutation.
- d) missense mutation.
- e) synonymous mutation.

10. Assume that during DNA replication in a bacterium a mistake is made and a G is inserted

into the newly synthesized DNA strand opposite a T in the template DNA strand. If this mistake is not repaired before the next round of DNA replication, what mutation will eventually result?

- a) A-to-G base substitution
- b) A-to-C base substitution
- c) A-to-T base substitution
- d) G-to-A base substitution
- e) C-to-A base substitution

11. _____ mutations produce new activities and are usually dominant.

- a) Induced
- b) Spontaneous
- c) Forward
- d) Gain-of-function
- e) Lethal

12. Which of the following types of mutations does NOT lead to a change in the amino acid

sequence of the gene product?

- a) Missense
- b) Nonsense
- c) Neutral
- d) Silent
- e) Loss-of-function

13. _____ bonds are found between paired bases of the DNA double helix, and _____ bonds are

found between paired bases of codons and anticodons.

- a) hydrogen..... hydrogen
- b) ionic..... hydrogen
- c) hydrogen ionic
- d) ionic ionic
- e) covalent hydrogen

14. Which of the following statements about the structure of the double helix of DNA is false?

- a) The strands that make up the DNA double helix are antiparallel.
- b) Purines bases complementary base pair with pyrimidine bases.
- c) The two strands of the double helix are held together by covalent bonds.
- d) The 5' to 3' direction of one strand runs opposite to the 5' to 3' direction of the other strand.
- e) None of the above, all the statements are true.

15. What phage reproductive cycle is observed if the phage infects a colony of bacteria and the

bacteria reproduce and propagate as usual, but the phage genome is incorporated into the bacteria genome?

- a) lytic cycle
- b) cell cycle
- c) sexual life cycle
- d) lysogenic cycle