Dental Microbiology Exam #1 Monday, September 15, 2008 12:30-2:30 p.m. Lecture Hall B and Room 386, 3rd Floor, Old Dental School Building

The Temple University School of Dentistry is guided by an Honor Code. All students are expected to abide by the Honor Code published by the Dental Student Handbook and are expected to maintain a high standard of professionalism and ethics as defined by the Ethical Foundation for Professional Education and Behavior.

There are a total of 62 questions on 11 pages in this exam.

Please use your TUID number on the scan sheet.

DIRECTIONS: For questions 1-3, Match the one lettered word or phrase associated with mutation and mutagenesis that best fits the numbered word or phrase. Letters may be used once, more than once or not at all.

- A. Base substitution
- B. Pyrimidine dimer
- C. Frame shift
- D. Suppressor mutation
- E. Insertion mutation
- 1. <u>B</u> Ultraviolet light
- 2. \underline{D} Mutant tRNA

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3. <u>A</u> 5-bromouracil

- 4. In conjugation between $F(^+)$ and $F(^-)$ *Escherichia coli*, which one of the following is true:
 - A. The process is sensitive to DNAse.
 - B. Chromosome transfer occurs at high frequency.
 - C. The $F(^+)$ factor is lost from the donor cell.
 - D. The donor cell usually dies.
 - \bigcirc Transfer of the F factor is infectious and all F⁻ bacteria in the population usually become F⁺.

- 5. As a preliminary to bacterial transcription, DNA-dependent RNA polymerase binds to:
 - The operon Α.

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- Β. The leader sequence
- C. D. The promoter
- The operator
- E. The attenuator
- 6. Combined antibiotic therapy (e.g. rifampicin plus isoniazid) is used to treat tuberculosis (TB) because
 - Α. *Mycobacteriun tuberculosis* grows slowly.
 - Β. Mycobacteriun tuberculosis contains plasmids encoding resistance to several antibiotics.
 - C. Mycobacteriun tuberculosis is an intracellular pathogen.
 - Resistance occurs by chromosomal mutation in Mycobacteriun tuberculosis and **/D**). the frequency of simultaneously obtaining two mutations to antibiotic resistance is very low.
 - E. Mycobacteriun tuberculosis is an extracellular pathogen.
- 7. The genetic events leading to the integration of the genome of bacteriophage λ into the chromosome of *Escherichia coli* are an example of (one best answer):
 - A. B. Conjugation
 - Site-specific RecA independent recombination
 - C. Restriction and modification
 - D. Generalized transduction
 - E. Transposon insertion
- 8. Which of the following is associated with lysogenic conversion:
 - Α. Edema factor and lethal factor of Bacillus anthracis
 - Β. Rifampicin resistance of *Mycobacterium tuberculosis*
 - Ø. Exotoxin production by Corynebacterium diphtheriae
 - DNA polymerase III
 - E. Capsule formation by *Streptococcus pneumoniae*
- Methicillin-resistant strains of Stapylococcus aureus (MRSA) are often also resistant to 9. other antibiotics because:
 - A. The strains are diploid.
 - Β. The strains contain a conjugative plasmid carrying multiple resistance determinants.
 - Staphylococcus aureus replicates its DNA with an error-prone polymerase, and so C. mutates at very high frequency, producing multiply mutated derivatives.
 - \vec{D} The strains have a chromosomal mobile genetic element that contains several resistance determinants.
 - Methicillin is mutagenic, producing multiply mutated derivatives. E.

- 10. The *lac* operon of *Escherichia coli* is associated with utilization of lactose as carbon source. Loss of the ability to utilize lactose as carbon source could be caused by all of the following, EXCEPT:
 - B. A deletion of the gene for the repressor of the lac operon
 - A deletion of the *lac* operon
 - C. A deletion of *lacZ*, the structural gene for β -galactosidase
 - D. A deletion of *lacY*, the structural gene for β -galactoside permease
 - E. A nonsense mutation in *lacZ*, the structural gene for β -galactosidase
- 11. *crp* is the structural gene for the CRP protein (also called CAP) that is associated with catabolite repression in Escherichia coli. All of the following statements are true EXCEPT:
 - A. The CRP protein binds to cAMP.
 - B. C. Deletion of *cap* causes constitutive expression of the lactose operon.
 - CRP modulates the response to glucose.
 - D. CRP recognizes and binds to a particular DNA sequence, which is found near the promoter of the lactose operon.
 - E. CRP is an example of a global regulator of transcription...
- 12. All of the following are true of bacteriophage EXCEPT:
 - Ð? They replicate by binary fission.
 - B. They can be lytic or lysogenic.
 - C. They attach to specific receptors on the bacterial surface.
 - D. They are assayed by their ability to form plaques.
 - E. Infection by bacteriophage is resistant to DNAse.
- 13. With respect to encapsulated strains of Streptococcus pnemoniae, which give smooth colonies, all of the following are true, EXCEPT:
 - They are virulent and can cause pneumonia in the elderly. A. B
 - Heat-killed smooth strains are also virulent.
 - C. There are different carbohydrate capsule types.
 - Subculturing can give rise to non-virulent, non-encapsulated strains which form D. rough colonies.
 - E. Mixing a live rough strain with a heat-killed smooth strain can give rise to a live, virulent strain as a result of transformation.
- A large number of transposons have been described for a range of gram-positive and 14. gram-negative species. Transposons have been found with each of the following properties EXCEPT:
 - (A). B. Replicate autonomously
 - Harbor antibiotic resistance genes
 - C. Carry a gene that directs transposition
 - Mediate plasmid-free conjugation D.
 - E. Cause mutation by inserting into a gene.

15. All of the following statements are true EXCEPT:

- Transductants resulting from specialized transduction carry phage genes. A.
- Β. Bacteriophage lambda can carry out specialized transduction.
- Ô Transductants resulting from generalized transduction carry phage genes.
- Generalized transduction is resistant to DNAse treatment. D.
- Generalized transduction involves homologous, RecA-mediated recombination. E.
- A strain of *Escherichia coli* is isolated with the following properties: 16.

It is resistant to tetracycline, and can transfer this resistance trait to sensitive strains. The resistant strains thus formed also acquire the ability to transfer the resistance trait to other recipient strains. The transfer process requires cell-to-cell contact between donor and recipient and is resistant to DNAse treatment. The transfer process is probably:

- A. Generalized transduction
- Specialized transduction B.
- C Conjugation
- Transformation D.
- E. Frame-shift mutation
- A gene encoding which of the following would confer resistance to vancomycin? 17.
 - a beta-lactamase A.
 - B an efflux pump
 - C. a penicillin binding protein (PBP)
 - D. a methyltransferase
 - E. an acetylase
- 18. Generally bacterial membranes:
 - Α. cannot block antibiotics.
 - BC. contain phosphatidyl-ethanolamine and phosphatidyl-glycerol.
 - contain sterols.
 - D. have porins in the inner (cytoplasmic) membrane.
 - E. have peptidoglycan in them.
- Endotoxic shock is associated only with Gram-negative bacteria because only Gram-19. negative bacteria:
 - can cause a septicemia. Α.
 - contain an outer membrane. Β/
 - Ĉ. can colonize the intestinal tract.
 - contain peptidoglycan. D.
 - E. have porins.
- Which of the following is a discrete layer of polysaccharide or polypeptide surrounding a 20. bacterial cell?

- The cell wall Capsule
- Outer membrane
- D. Matrix (slime layer)
- E. Fibrils

- 21. When glucose is transported into a bacterial cell by the PTS (phosphotransferase system) it is converted to glucose-6-phosphate. This is an example of:
 - facilitated diffusion.
 - (B? group translocation.
 - C. free diffusion.
 - D. Type III transport.
 - E. Type I transport.
- 22. All of the following are true of normal flora EXCEPT:
 - Normal flora are present on the skin. A Ø
 - Normal flora are composed only of non-pathogenic bacteria.
 - C. Normal flora are present in the colon.
 - D. Normal flora are present in the respiratory tract.
 - E. Normal flora are present in the vagina.
- 23. The substitution of D-Alanine (D-Ala) with D-Lactate (D-Lac) prevents the activity of which class of antibiotics?
 - Α. Macrolide
 - Trimethoprim B
 - Ć, Vancomycin
 - Ouinolone D.
 - E. Bacitracin
- 24. The production of acid during growth indicates the bacterium:
 - Α. produces 2-3 butanediol as an end product of fermentation.
 - Β. uses respiration to produce energy.
 - Ċ uses fermentation to produce energy.
 - Ď. produces carbon dioxide as an end product of fermentation.
 - E. uses urease to obtain ammonia.
- 25. A positive indole test indicates the bacteria can obtain:
 - B. ammonia from tryptophan.
 - ammonia from urea.
 - C. pyruvate from lysine.
 - D. pyruvate from threonine.
 - E. ammonia from arginine.
- 26. Which of the following is important for bacterial growth?
 - Α. Temperature
 - Β. Iron (Fe)
 - C. pН
 - Salt concentration
 - All of the above are important

- 27. Some bacterial species will use what type of secretion system to inject toxins into eukaryotic cells?
 - Type I Α.
 - В, Type II
 - Ć Type III
 - D. Type IV
 - Type V E.
- 28. The alcohol wash step of the Gram stain will:
 - Α. remove safranin from Gram-positive bacteria.
 - B. remove the cell wall.
 - Ø. remove safranin from Gram-negative bacteria.
 - remove crystal violet from Gram-negative bacteria.
 - E remove crystal violet from Gram-positive bacteria.
- 29. Bacitracin inhibits:
 - A. transpeptidation.
 - B. the addition of D-Ala to the UDP-NAM (UDP N-acetyl muramic acid) subunit.
 - C. glycosylation.
 - D. the conversion of N-acetyl-glucosamine (NAG) to N-acetyl muramic acid (NAM).
 - Æ. the recycling of the undecaprenyl carrier.
- 30. A bacterium that is sensitive to aminoglycosides uses which process to generate ATP?
 - B. Aerobic respiration
 - Mixed acid fermentation
 - C. Homolactic fermentation
 - D. Heterolactic fermentation
 - E. Anaerobic respiration
- 31. With respect to determining antibiotic sensitivity:
 - A The criterion for resistance is that bacteria are not inhibited or killed by the clinically achievable dose.
 - In a disk diffusion assay, the size of the zone of inhibition (clearing) for resistant B. bacteria is the same for all antibiotics.
 - C. Resistant bacteria generally do not have any zone of inhibition (clearing) around the disk.
 - D. The criterion for resistance is that bacteria are not inhibited or killed by 1/4 the clinically achievable dose.
 - The criterion for resistance is that bacteria are not inhibited or killed by 1/2 the E. clinically achievable dose.
- During fermentation, which molecule is reduced to recycle NADH + H^+ to NAD? 32.

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sulfate. Α. thiosulfate. pyruvate. nitrate. oxygen.

Macrolides directly inhibit: 33.

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- DNA synthesis.
- A. protein synthesis.
- Č. transcription.
- D. folic acid synthesis.
- E. cell wall synthesis.
- The primary colonizing bacterial species for the formation of a healthy dental biofilm 34. (plaque) are:
 - different between individuals. A. Br
 - Streptococcal species with the exception of Streptococcus mutans.
 - from numerous genera that can adhere to the acquired pellicle. C.
 - generally are divided into clusters (e.g. orange cluster). D.
 - E. Fusobacterium nucleatum.
- 35. The bridge between early and late colonizers is formed by:
 - bacterial species which are divided into clusters (e.g. orange cluster). Α.
 - Streptococcal species with the exception of Streptococcus mutans. Β.
 - C. different species between individuals.
 - numerous genera that can adhere to the acquired pellicle. D.
 - Fusobacterium nucleatum. Æ.)
- 36. Antibiotics that are inactivated by O-adenylation directly inhibit which cellular process?
 - A. Replication
 - Β. Cell wall synthesis
 - O. **Protein synthesis**
 - D. Lipid synthesis
 - E. Transcription
- Sulfonamides directly inhibit the production of all of the following cellular components 37. EXCEPT:
 - Α. DNA.
 - Β. RNA.
 - C. tRNA.
 - D. proteins.
 - Æ) fatty acids.
- Mutations that give the bacteria resistance to tetracyclines are likely to arise in the: 38.
 - PBPs (penicillin binding proteins).
 - Β. 30S ribosomal subunit.
 - Ĉ. 50S ribosomal subunit.
 - D. DNA gyrase.
 - E. RNA polymerase.

- 39. Treatment of sensitive bacteria with penicillin will directly result in:
 - Α. inhibition of sugar transport into the bacteria.
 - B. inhibition of genetic exchange.
 - C. inhibition of active transport.
 - inhibition of segregation of the chromosome copies at cell division. D.
 - (Ê) lysis of the bacterial cell.
- 40. Why is a beta-lactamase inhibitor used in conjunction with penicillin?
 - A. One inhibits cell wall synthesis, while the other inhibits protein synthesis.
 - B. It makes penicillin active against Gram-negative bacteria.
 - C. They both are active against the same molecular target, hence are synergistic.
 - D. It makes penicillin bactericidal.
 - Æ) It inhibits the resistance mechanism to penicillin.
- 41. In general, differential media:
 - are only useful for differentiating facultative anaerobes from strict anaerobes.
 - A B allow most organisms to grow, but makes the colonies look different.
 - Ċ. inhibit the growth of selected groups of bacteria.
 - D. are only useful for Gram-positive bacteria.
 - E. enable the differentiation of Gram-positive versus Gram-negative bacteria.
- 42. Fastidious bacteria:
 - Α. do not cause disease.
 - grow very fast.
 - require special media components.
 - D. are not culturable.
 - E. are obligate intracellular pathogens.
- 43. Floroquinolones bind:
 - the 30S ribosomal subunit.
 - P. C. DNA gyrase.
 - RNA polymerase.
 - D. LPS (lipopolysaccharide).
 - E. the 50S ribosomal subunit.
- Transglycosylation and transpeptidation activity of penicillin binding proteins is inhibited 44. by:
 - A. Cycloserine.
 - Macrolides.
 - Beta-lactams
 - Fosfomycin.
 - Bacitracin.

- 45. Which of the following provides intrinsic resistance to antibiotics?
 - A. Beta-lactamase production
 - B. Plasma membrane
 - C. **Ribosomal mutations**
 - D Some Type I secretion systems
 - Some Type III secretion systems
- 46. Gram-positive bacterial cells:
 - have a thick layer of peptidoglycan between two membranes. А.
 - B have a single cytoplasmic membrane.
 - Ċ.
 - have an amino side chain attached to the N-acetylglucosamine (NAG). can have a crosslink from the 1st amino acid in one subunit to the 2nd amino acid D. of a second subunit.
 - E. have LPS (lipopolysaccharide) associated with the cell wall.
- 47. Bacterial growth:
 - Α. is rapid in lag phase.
 - B. occurs by budding.
 - results in linear increases in bacterial numbers.
 - C. D E. is exponential.
 - ceases upon entrance into stationary phase when the bacteria immediately die.
- A complete zone of clearing around a bacterial colony on a blood agar plate is what kind 48. of hemolysis?
 - Alpha
 - Beta
 - Gamma
 - D. Delta
 - E Mu
- 49. Aerotolerant bacteria are:
 - Α. anaerobic bacteria that are killed by oxygen.
 - aerobic bacteria that can tolerate oxygen. Β.
 - C. anaerobic bacteria that prefer reduced oxygen tension for growth.
 - D. E. anaerobic bacteria that can withstand oxygen.
 - aerobic bacteria that can grow without oxygen.
- Which of the following antibiotics inhibits peptide bond formation during translation? 50.

- Lincosamides Streptogramins
- В. C. Cycloserine
- Ð.
- Fosfomyin (phosphomycin)
- Z. Polymyxin

- Which of the following antibiotics prevents the attachment of D-Alanine (D-Ala) to the 51. peptide chain of peptidoglycan subunits?
- B
- Lincosamides
- Cycloserine
- Fosfomyin (phosphomycin)
- Streptogramins Polymyxin
- 52. Which of the following antibiotics can kill non-growing bacteria?
 - Α. Fosfomyin (phosphomycin)
 - Β. Cycloserine
 - Beta-lactams
 - Polymyxin
 - Vancomycin
- 53. Monocytes engulf bacteria into:
 - A. a lysozyme
 - B. the endoplasmic reticulum
 - C. the Golgi apparatus
 - D E a lysosome
 - a phagosome
- 54. Macrophages eliminate many microbes by:
 - Α. killing them with Defensins and Cationic Proteins.
 - ingesting the microbes into their preformed large lysosomal primary granules. Β.
 - generating peroxide using the enzyme myeloperoxidase
 - Ē. producing nitric oxide and peroxynitrite that are microbicidal.
 - secreting IL-10 that is microbicidal.
- 55. Toll-Like Receptors (TLRs) are expressed most abundantly on:
 - A. Lymphocytes
 - Β. Natural Killer Cells
 - C. Liver parenchymal cells
 - D. Fibroblasts
 - (E.) Monocyte/macrophages
- 56. Regarding Toll-Like Receptors (TLRs):
 - 48 such receptors have been identified.
 - They are Pattern Recognition Receptors with broad specificity.
 - They only recognize products of bacteria, not products of fungi or viruses.
 - D. They are receptors for interleukins.
 - Their engagement with microbial products leads directly to increased antibody E. production.

- 57. Chronic Granulomatous Disease of Childhood (CGD):
 - \mathcal{Q} is due to defective production of peroxide in PMNs.
 - is due to a defect in macrophage granuloma formation. Β.
 - C. is associated with increased resistance to most bacteria.
 - is associated with defective protein synthesis in PMNs. D.
 - E. is due to failure to produce defensins.
- Which of the following is/are most prominently involved in the process by which PMNs 58. leave the circulation in response to microbial invasion?
 - Engagement of Toll-Like Receptors (TLRs) Α.
 - Β. Nitric oxide production by endothelial cells
 - Tighter adhesion to endothelial cells mediated by cellular adhesion molecules \mathcal{O} (CAMs)
 - Signals from Natural Killer cells to PMNs D.
 - E. Signals from T cells to PMNs
- 59. In regard to proinflammatory cytokines:
 - A⊂ B. IL-12 causes fever.
 - IL-1 activates NK cells.
 - C. TNF-alpha causes PMNs to degranulate.
 - Many of them are released when bacterial lipopolysaccharide (LPS) binds to D) TLR-4.
 - E. PMNs are the main source for their production.
- 60. In regard to host-pathogen interactions:
 - Virulence of a pathogen can be quantitated by its LD₅₀ in an animal model.
 - Β. Attenuated organisms cannot kill a host.
 - Genetic factors in the host play no role in determining susceptibility to microbial C. infection.
 - The LD₅₀ of an organism would be decreased in a vaccinated host. D.
 - A person on chemotherapy would have an increased LD_{50} to many pathogens E. compared to a normal host.
- 61. Cytokines:
 - Α. Are polysaccharides
 - Are mostly produced by PMNs. Β.
 - When released, are usually harmful to the host C.
 - D. Bind to microbes and kill them.
 - Ð Generate an inflammatory response
- 62. Natural Killer Cells:
 - are phagocytic. Α.
 - B. are a type of macrophage.
 - kill virally infected cells by a contact mechanism. C.
 - have receptors for specific viruses on their surface. D.
 - E) produce nitric oxide