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Dental Microbiology Exam #1 Monday, September 17, 2007 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 55 questions on 11 pages in this exam.

Please use your TUID number on the scan sheet.

DIRECTIONS: For the following questions, select the ONE BEST answer in each case.

- 1. A polymorphonuclear leukocyte (PMN) initially engulfs bacteria into the:
 - A. endoplasmic reticulum
 - golgi apparatus
 - phagosome
 - D. lysosome
 - E. phagolysosome
- 2. Patients with Chronic Granulomatous Disease of Childhood have a deficiency of:
 - peroxide
 - B. nitric oxide
 - C. defensins
 - D. cationic proteins
 - E. Ca++
- √<u>3</u>.

Mononuclear phagocytes:

- A. Are found only in the blood
- B. Mainly kill fungi not bacteria
 - Have myeloperoxidase -
- Have a short half-life of days Can be induced to make nitric oxide which is microbicidal
- Toll-Like Receptors (TLRs) of monocytes and macrophages:
- 2-

- ß
- Bind antibodies
- Signal the cell to make cytokines when they bind their ligands
- Have hundreds of different types
- Bind flagella but not bacterial DNA
- Recognize small differences between molecules of similar types on microbes

√5. Phagocytes move from the blood stream into the tissue spaces by:

- Adhering to endothelial cells using Toll-Like Receptors.
- (B. A process of diapedesis followed by rolling
- Excreting nitric oxides C.
 - D. Adhesion mediated by ICAMs
 - Ē. Adhesion mediated by IL-1
- Cytokines: Connumbin 6.
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 - Α. Are polysaccharides
 - Are stored in phagosomes of phagocytic cells ₿, Ø,
 - Usually decrease the activity of Natural Killer cells
 - Đ. Act as cell receptors for microbes
 - E) Generate an inflammatory response
- √_{7.}

A

B

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Below are three LD₅₀ curves. Each point on the curves represents the mortality rate for 10 mice. The mortality curve using normal (wild-type mice) of an isolate of virulent Streptococcus pneumoniae from a patient that died of pneumococcal pneumonia is shown in the line labeled 'B'.



Line C could represent an attenuated variant of the strain of S. pneumoniae, which lost the capacity to make capsule.

- Line A is a live, vaccine strain of S. pneumoniae.
- Line C is the LD₅₀ of S. pneumoniae in an immunocompromised host.

Line A is the LD_{50} , in a strain of mice that was bred to be resistant to S. pneumoniae. ? Myl.

If Line B is the LD_{50} curve in male mice, and female mice are (100) times as resistant to S. pneumoniae as the males, then curve A could represent the curve in female mice.

DIRECTIONS: 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
- 8. <u>V</u> Mutant tRNA
- 9. λ 5-bromouracil
- 10. <u>B</u> Ultraviolet light

DIRECTIONS: For the following questions, select the ONE BEST answer in each case.

- 11. In conjugation between F^+ and F^- *Escherichia coli*, which one of the following is true:
 - A. The donor cell is F^{-} .
 - B. The process is sensitive to DNAse.
 - C. The F factor is lost from the donor cell.
 - D. Transfer of the F factor is infectious and all F bacteria in the population usually become F⁺.
 - E. The F^+ and F^- strains fuse to form a diploid strain.
- 12. Termination of transcription by bacterial RNA polymerase is associated with which of the following factors:
 - A. Alpha
 - B. Beta
 - C. Rho
 - D. Sigma
 - E. Omega
- 13. Combined antibiotic therapy (e.g. rifampicin plus isoniazid) is used to treat tuberculosis (TB) because
 - A. Mycobacteriun tuberculosis grows slowly
 - B. *Mycobacteriun tuberculosis* contains plasmids encoding resistance to several antibiotics
 - C. Mycobacteriun tuberculosis is an intracellular pathogen
 - D. Resistance occurs by chromosomal mutation in *Mycobacteriun tuberculosis* and the frequency of simultaneously obtaining two mutations to resistance is very low
 - E. Mycobacteriun tuberculosis is an extracellular pathogen

- The following are true about transposons EXCEPT they: 14.
 - are replicons
 - can harbor antibiotic resistance genes \checkmark
 - may carry a gene that directs transposition \checkmark
 - may mediate plasmid-free conjugation \checkmark
 - can cause mutation by inserting into a gene!
- Which of the following is associated with lysogenic conversion: 15.
 - A) B. Exotoxin production by Corynebacterium diphtheriae
 - Rifampicin resistance of Mycobacterium tuberculosis
 - C. Edema factor and lethal factor of Bacillus anthracis
 - D. DNA polymerase III
 - Capsule formation by Streptococcus pneumoniae E.
- Expression of the lac operon of Escherichia coli is required for the utilization of lactose 16. as a carbon source. Loss of the ability to utilize lactose as a carbon source could be caused by all of the following, except:
 - Α. A deletion of the lac operon
 - A nonsense mutation in *lacZ*, the structural gene for β -galactosidase Β.
 - A deletion of *lacZ*, the structural gene for β -galactosidase C.
 - A deletion of *lacY*, the structural gene for β -galactoside permease D.
 - A deletion of the gene for the repressor of the lac operon (E.)
- cap is the structural gene for the CAP protein (also called CRP) that is associated with 17. catabolite repression in Escherichia coli. All of the following statements are true except:
 - A. B. K. Deletion of cap causes constitutive expression of the lactose operon.
 - CAP is an example of a global regulator of transcription.
 - CAP regulates the response to glucose.
 - CAP recognizes and binds to a particular DNA sequence, which is found near the D. _ promoter of the lactose operon.
 - K The CAP protein binds to cAMP.
- 18. All of the following are true of bacteriophage except:
 - ₩. ₩. They are assayed by their ability to form plaques.
 - They can be lytic or lysogenic.
 - C. D. They attach to specific receptors on the bacterial surface.
 - Infection by bacteriophage is sensitive to DNAse.
 - Phage DNA is packaged in phage heads within the infected bacteria.
- J_{19.} 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
- Heat-killed smooth strains are also virulent
 - There are different carbohydrate capsule types
- Subculturing can give rise to non-virulent, non-encapsulated strains which form rough colonies
- Mixing a live rough strain with a heat-killed smooth strain can give rise to a live, virulent strain as a result of transformation.

- 20. With respect to methicillin-resistant *Staphylococcus aureus* (MRSA) all of the following are true EXCEPT:
 - X. Are common nosocomial (hospital-acquired) isolates Appeared within a few years of the introduction of the
 - Appeared within a few years of the introduction of methicillin as an anti-bacterial agent
 - Generally have acquired a point mutation that results in the resistance
 - Encode a penicillin-binding protein that is resistant to methicillin
 - Are typically resistant to several antibiotics
- 21. As a preliminary to bacterial transcription, RNA polymerase binds to:
 - A. The operator
 - B. The ribosome-binding site
 - C/ The promoter
 - D. The operon
 - E. The terminator
- 22. The following property is associated with restriction endonucleases:
 - \underline{A} modifies DNA
 - cuts DNA at a defined sequence recognized by the enzyme
 - C. cuts "headfuls" of DNA
 - D. cuts RNA as well as DNA
 - E. proofreads during DNA replication
- 23. A strain of *Escherichia coli* is isolated with the following properties:

It is resistant to tetracycline because of the presence of a *tet* gene. It can transfer the *tet* gene to a strain that had been sensitive to tetracycline. The strain thus formed also acquires the ability to transfer the *tet* gene to another recipient, sensitive strain. The transfer process requires cell-to-cell contact between donor and recipient. The strain in question probably:

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- X. is an Hfr strain
- B. contains a specialized transducing phage
- C. contains a generalized transducing phage
- is able to release its DNA which acts as donor for transformation of a suitable,
- <u>competent recipient strain</u>
- E contains a conjugative plasmid
- 24. Which of the following is a possible mechanism for resistance to vancomycin?

A B. C. D. E.	an efflux pump a penicillin binding protein a beta-lactamase a methyltransferase an acetylase	fer C- B B	
		\checkmark	

- 25. Gram positive cells have
 - a single membrane.
 - an amino acid side chain attached to the N-acetylglucosamine (NAG). Ð.
 - a thick layer of peptidoglycan between two membranes. Ć.
 - Ø. LPS (lipopolysaccharide) associated with the cell wall.
 - can have a crosslink from the 1st amino acid in one subunit to the 2nd amino acid E) of a second subunit.
- 26 Bacterial membranes
 - contain sterols.
 - have porins in the inner (cytoplasmic) membrane.
 - have peptidoglycan in them.
 - contain phosphatidyl-ethanolamine and phosphatidyl-glycerol.
 - cannot block antibiotics.
 - Endotoxic shock is associated only with Gram-negative bacteria because only Gram-27. negative bacteria
 - Α. can cause a septicemia
 - Β. can colonize the intestinal tract
 - C. contain peptidoglycan
 - D, contain an outer membrane
 - contain porins
 - Which class of antibiotics tends to have poor specificity for bacteria and, therefore, 28. primarily used in topical antibiotic preparations (e.g. Triple Antibiotic Ointment)?
 - Ã. Polymxyin
 - В. Chloramphenicol
 - C. Tetracycline
 - D. Vancomycin
 - E. Rifampicin
- 29. Which of the following is a discrete layer of polysaccharide or polypeptide surrounding a bacterial cell?
 - (**A**.) capsule
 - Β. outer membrane
 - С. matrix (slime layer)
 - D. the cell wall
 - E. fibrils
- 30. 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
 - Α. facilitated diffusion.
 - Β. Type III transport.
 - C D Type I transport.
 - group translocation.
 - free diffusion.

- 31. All of the following are true of normal flora EXCEPT:
 - A. Normal flora are present on the skin.
 - B. Normal flora are present in the colon.
 - C. Normal flora are present in the vagina.
 - Normal flora are present in the respiratory tract.
 - Normal flora are composed only of non-pathogenic bacteria.
- 32. Which of the following provides intrinsic resistance to antibiotics?

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- plasma membrane
- outer membrane
- some Type IV secretion systems
- **D** beta-lactamase production
- **E** ribosomal mutations
- 33. The substitution of D-Alanine (D-Ala) with D-Lactate (D-Lac) prevents the activity of which class of antibiotics?
 - A. Trimethoprim
 - B. Macrolide
 - <u>C.</u> Quinolone
 - D. Vancomycin
 - E. Bacitracin
- 34. The production of acid during growth indicates the bacterium
 - A. uses respiration to produce energy.
 - B) uses fermentation to produce energy.
 - C. produces carbon dioxide as an end product of fermentation.
 - D. produces 2-3 butanediol as an end product of fermentation.
 - E. uses urease to obtain ammonia.
- 35. A positive indole test indicates the bacteria obtain
 - A. ammonia from urea
 - **B**. ammonia from tryptophan
 - C. ammonia from arginine
 - D. pyruvate from lysine
 - E. pyruvate from threonine
- 36. Which of the following is important for bacterial growth?
 - A. temperature
 - B. pH
 - C. salt concentration
 - iron (Fe)
 - E. all of the above are important.

- Some bacterial species will use what type of secretion system to inject toxins into 37. eukaryotic cells?
 - А. Type I Type II Type III Type IV

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- E. Type V
- 38. The alcohol wash step of the Gram stain will
 - A. B. remove crystal violet from Gram-negative bacteria.
 - remove crystal violet from Gram-positive bacteria.
 - C. remove safranin from Gram-negative bacteria.
 - D. remove safranin from Gram-positive bacteria.
 - E. remove the cell wall.

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- 39. Bacitracin inhibits
 - the addition of D-Ala to the UDP-NAM (UDP N-acetyl muramic acid) subunit. Α.
 - the conversion of N-acetyl-glucosamine (NAG) to N-acetyl muramic acid Β. (NAM).
 - the recycling of the undecaprenyl carrier. Ć.
 - D. glycosylation.
 - E. transpeptidation.
- To which aspect of bacterial metabolism/biosynthesis have we NOT produced a clinically 40. useful antibiotic?
 - Α. folic acid biosynthesis
 - B. C protein synthesis
 - acquisition of iron
 - D. **RNA** synthesis
 - E. DNA synthesis
- A bacterium that is sensitive to aminoglycosides generates ATP through 41.

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homolactic fermentation. anaerobic respiration.

mixed acid fermentation.

aerobic respiration.



42. With respect to determining antibiotic sensitivity

> R In a disk diffusion assay, the size of the zone of inhibition (clearing) for resistant bacteria is the same for all antibiotics.

> R Resistant bacteria generally do not have any zone of inhibition (clearing) around the disk.

- Ĉ. The criterion for resistance is that bacteria are not inhibited or killed by the clinically achievable dose.
- The criterion for resistance is that bacteria are not inhibited or killed by 1/2 the D. clinically achievable dose.
- The criterion for resistance is that bacteria are not inhibited or killed by 1/4 the E. clinically achievable dose.
- 43. In fermentation, which molecule is reduced to recycle NADH + H^+ to NAD?
 - Ð pyruvate
 - B. nitrate
 - С. thiosulfate
 - D. oxygen
 - E. sulfate

44. Folic acid synthesis is directly inhibited by

- Α. Vancomycin
- B. Rifampicin
- G. Trimethoprim
- Cycloserine
- E. Tetracycline
- 45. Macrolides directly inhibit
 - Α. DNA synthesis.
 - Β. transcription.
 - Ç. D/ folic acid synthesis.
 - protein synthesis.
 - cell wall synthesis. E.
- All of the following are true of dental biofilms (plaque) EXCEPT: 46.
 - Α. Streptococci bind to the acquired pellicle.
 - Numerous other genera adhere to the streptococci, composing the early Β. colonizers.
 - Fusobacterium nucleatum forms a bridge between early and late colonizers. Æ. D.
 - The mature biofilm is highly diverse and many species in the plaque have not been cultured.
 - Έ! The species that compose the biofilm differ from individual to individual, but the biofilm composition is the same on all teeth in a single individual.

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- 47. Antibiotics that are inactivated by O-adenylation directly inhibit which cellular process?
 - replication

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- protein synthesis
- transcription
- D. cell wall synthesis
- E. lipid synthesis
- Sulfonamides directly inhibit the production of all of the following cellular components 48. EXCEPT
 - RNA
 - B. fatty acids
 - proteins
 - D. tRNA
 - E. DNA
- Mutations that give the bacteria resistance to tetracyclines are likely to arise in the 49.
 - 30S ribosomal subunit

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- B. 50S ribosomal subunit C. DNA gyrase
- D. **RNA** polymerase
- E. PBPs (penicillin binding proteins)
- Treatment of sensitive bacteria with penicillin will directly result in 50.
 - inhibition of sugar transport into the bacteria. Α.
 - inhibition of segregation of the chromosome copies at cell division. B C
 - lysis of the bacterial cell.
 - Ď. inhibition of genetic exchange.
 - E. inhibition of active transport.
- 51. Why is clavulanic acid mixed with penicillin?
 - One is active against Gram-positive bacteria, while the other is active against Α. Gram-negative bacteria.
 - One is bacteriostatic, while the other is bactericidal. B.
 - They both are active against the same molecular target, hence are synergistic.
 - Clavulanic acid inhibits the resistance mechanism to penicillin. D,
 - One inhibits cell wall synthesis, while the other inhibits protein synthesis.
- 52. In general, differential media
 - allow most organisms to grow, but make them look dissimilar.
 - inhibit the growth of selected groups of bacteria.
 - are only useful for gram-positive bacteria. С.
 - are only useful for differentiating facultative anaerobes from strict anaerobes. D. E.
 - enable the differentiation of gram-positive versus gram-negative bacteria.

53. Fastidious bacteria

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- Α. grow very fast.
- do not cause disease. Β.
- are not culturable. C.
- require special media components. D.
 - are obligate intracellular pathogens.
- Which type of transporter can serve as an antibiotic efflux pump? 54.
 - (Â.) B. Type I
 - Type II
 - C. Type III
 - D. Type IV
 - E. Type V
- Which of the following antibiotics directly inhibits DNA gyrase? 55.
 - Å. Æ? Rifampicin
 - Bacitracin
 - Floroquinolones
 - Chloramphenicol
 - Lincosamides E.