

Systems Microbiology 1.084J/20.106J PROBLEM SET #5 – Due Wednesday Nov. 22nd

Problem 5.1

- a. In which settings would it be appropriate to achieve sterilization by (i) autoclaving, (ii) γ irradiation, (iii) ethylene oxide gas, (iv) cold sterilization using a liquid, and (v) filtration. Give an example of each.
- b. How would you sterilize 1 liter of a viscous oil such as mineral oil (liquid petrolatum)?

Problem 5.2

Why is pasteurization of milk beneficial? Do you think sterilization of milk would provide significant advantages over pasteurization? Explain your reasoning.

Problem 5.3

- a. Pick an antimicrobial drug and describe its mechanism of action.
- b. Describe 2 separate mechanisms by which bacteria could develop resistance to this drug.
- c. Describe a strategy that could be used to augment and/or modify your original drug to make it effective against bacteria that have acquired resistance.
- d. In the escalation of antimicrobials versus antimicrobial resistance, who will ultimately win out – the pharmaceutical industry or infectious bacteria? Explain your reasoning.

Problem 5.4

- a. As drug companies search for new targets for antimicrobial chemotherapy, some consideration has been given to identifying essential genes in pathogenic bacteria that are only expressed *in vivo* (i.e. not expressed when the bacterium is grown on artificial growth media in the laboratory). What would be the advantage of developing drugs that act against such targets?
- b. What would be the disadvantage of using these drugs in a clinical setting? Hint: how are clinical isolates routinely tested for antimicrobial susceptibility?

Problem 5.5

Do you think the forces that shape genome structure and evolution for *Buchnera aphidicola*, the endosymbiont of aphids, also act on autochthonous microbiota in the human gut? Describe what you think are the major similarities and/or differences between the systems, and the consequences for genome structure and evolution of intestinal microbial species.

Problem 5.6

Give one example of an approach or technique that has been used to characterize environmental microbial communities that could be applied to the human gut microbiota. If you were a member of a funding agency panel would you endorse (i.e. pay for) such a study? Why?