

Problem Set 5: Development / Acoustic Trauma and Repair

Due: 12-3-2004

Problem 1.

Suppose that a particular drug, when given to mice soon after insemination, dramatically affects development of the neural tube and cochlea of the offspring. Describe a course of observations/experiments that could be performed to determine the cause of the inner ear defects. How would you determine whether the problem was due to defects in induction, specification, and/or commitment?

Problem 2.

Why might type II fibrocytes and strial marginal cells be more vulnerable to damage than other cells in the lateral wall following overexposure to traumatizing noise? If the organ of Corti (OC) is destroyed by such noise why might type II fibrocytes apical and basal to the site of OC destruction be damaged far more than those adjacent to the site of OC destruction? If there is severe damage to the organ of Corti and stria vascularis following noise trauma, EP can regain its normal value. Explain how this can occur.

Problem 3.

The maximum threshold shift seen after acoustic overexposure to a narrow-band stimulus such as a pure tone is often seen at frequencies 1/2 octave above the exposure frequency. Use what you have learned about the vibration of the basilar membrane in response to stimuli on and off CF to explain this curious observation.

Problem 4.

Overexposure to loud noise can cause permanent threshold shifts. Pre-exposure to physical stresses, such as elevation of body temperature (heat stress), or psychological stresses, such as placing an animal in plastic tube which restricts movement (restraint stress), can "protect" the ear from acoustic injury. "Protection" means that pre-stressed individuals show less threshold shift from a subsequent acoustic trauma than control animals without the pre-exposure stress.

- a) Describe the functionally important damage to cells and structures that underlies the irreversible threshold shifts seen after noise.
- b) Discuss the molecular mechanisms underlying noise-induced cell death in the cochlea.
- c) The time interval between pre-stress and sound exposure is critical to the degree of protection: a stress-trauma interval of 6-12 hours provides maximal protection in many cases. What does the requirement for a time interval of this magnitude suggest about the mechanism of protection?
- d) Discuss the molecular mechanisms which might underlie induction of a protected state in the cochlea.

