MIDTERM 2
MCB 160, SPRING 2007
100 points
7 questions
7 pages

BE SURE TO PUT YOUR NAME AT THE TOP OF EVERY PAGE!!!!!!!!!!!!
CHECK THAT YOU HAVE SEVEN QUESTIONS!!!
WRITE IN INK!!!

Name _____

SID # _____

GOOD LUCK!!!
Do not write below this line (for grading purposes only).

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1. /22

2. /22

3. /20

4. /14

5. /8

6. /6

7 /8

Total

1. G protein-coupled receptors allow cells to detect and respond to extracellular ligands. The signaling pathways for GPCRs diverge, allowing cells to have a variety of responses (22 pts).

A) Rodbell won the Nobel prize for discovering that GTP and ATP were necessary for cells to become activated by epinephrine. Why is ATP necessary (2 pts)? Why is GTP necessary (2 pts)?

B) Name the signaling molecules that are activated in response to odors in vertebrate olfactory neurons (6 pts).

C) Name the signaling molecules that are activated in response to pheromones in mouse vomeronasal neurons (6 pts).

D) A mouse pheromone receptor put into mouse olfactory neurons does not activate the olfactory signal transduction cascade. How could you engineer a G protein to couple to the pheromone receptor and activate the olfactory transduction cascade? (6 pts)

2) The visual system creates a topographic map of projections from the retina to the optic tectum. The molecular mechanisms underlying axon guidance in this system are becoming understood (22 pts).

A) What is a topographic map (6 pts)?

B. In the frog, axons from the left eye invade both the left and the right optic tectum. Early in development, projections are contralateral. Later in development, ispsilateral connections form. How does this occur (6 pts)?

C. Projections from the retina to the tectum in the green witch toad use unusual axon guidance molecules. A receptor tyrosine kinase called WIT is found on retinal axons, and its expression is graded from high to low along the anterior to posterior retina. Its ligand is a repulsive cue called WITL. WITL is found in the tectum, in a gradient from low to high along the anterior to posterior tectum. Where do anterior retinal axons synapse in the tectum (2 pts)? Posterior retinal axons (2 pts)?

D. If a dominant negative WIT (dnWIT) was expressed in the anterior half of the retina only and its expression was graded from low to high in the anterior retina, what would be different about the retinal-tectal map compared to C? Assume that WIT and WITL expression is the same as in C. Assume that low levels of dnWIT are the same as low levels of WIT, and high levels of dnWIT equal high levels of WIT. Explain your answer (6 pts).

3. Different cell layers of the cortex are generated during development (20pts).

A. Explain the model for how the layers of the cortex form (6 pts).

B A mouse mutant called "Tipsy" was identified because it has very poor motor coordination. A series of cortical transplantation experiments were done to determine whether there are defects in cortical development in this mouse. Progenitor cells were taken out of the mutant, labeled then put back into the mutant host to determine which layers the cells invade. These experiments were done in the embryonic day 30 animal and the embryonic day 36 animal. In addition, progenitors from embryonic day 30 were transplanted into embryonic day 36. Each experiment was done twice (the grey bar is one experiment, the black bar is the second experiment.) The results are shown below.
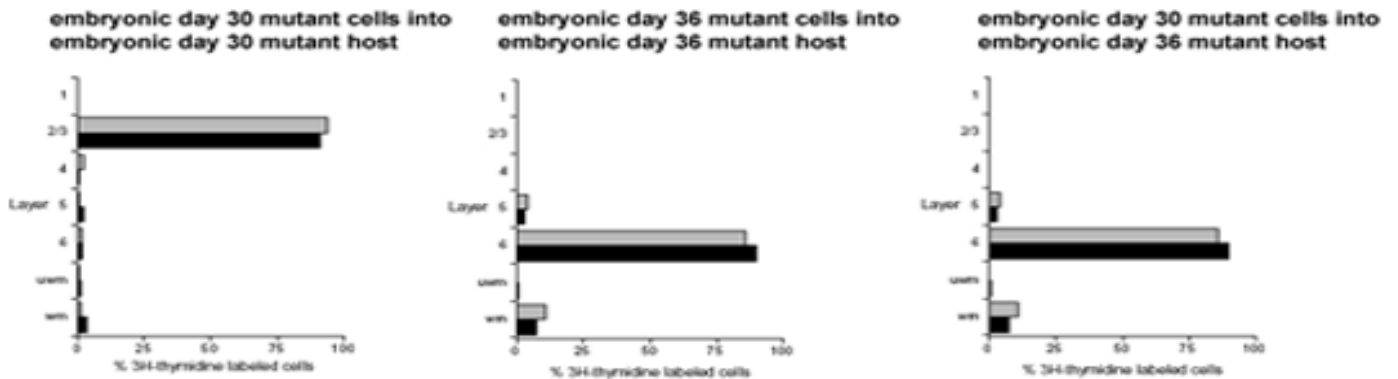
What is the defect in "Tipsy" mouse cortical development (6 pts)?

C. Design two experiments to test whether the defect is in the "Tipsy" cortical cells or the "Tispy" cortical environment (8 pts). Briefly describe the experiments and how you would interpret the results.

4. A. How does the ear transform sound into a change in neural activity? Describe the steps from a sound arriving at the outer ear to activation of hair cells. Be explicit; describe how sound vibrations are processed in the outer, middle and inner ear and how hair cell transduction occurs (8 pts).

B. How does calcium entry cause adaptation in hair cells (6 pts)?

5. Why are more men red-green colorblind than women (8 pts)?

6. Why don't cats taste sugars (6 pts)?

7. What is the signaling cascade leading to programmed cell death? How do neurotrophins affect this cascade? (8 pts)