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

Name

SID #

GOOD LUCK!!!

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

1. /18
2. /22
3. /20
4. /20
5. /20

Total
1. (21 pts total) Define the following developmental hypotheses (1-4 sentences each). For each hypothesis, name a secreted molecule that supports it, as discussed in class.

   A. Chemoaffinity Hypothesis (5 pts)

   Secreted molecule that supports the chemoaffinity hypothesis (1 pt):

   B. Neurotrophin Hypothesis (5 pts)

   Secreted molecule supporting the neurotrophin hypothesis (1 pt):

   C. Morphogen Hypothesis (5 pts)

   Secreted molecule supporting the morphogen hypothesis (1 pt):
2. (22 pts total)
   A. Sonic Hedgehog is important for patterning the ventral spinal cord. What molecule is important for patterning the dorsal spinal cord (2 points)?

   B. Name two experiments that would show this (based on the work with SHH) (5 points). (2-4 sentences)

   C. What would happen if you expressed Noggin in the roofplate? Why? (5 points) (1-2 sentences)

   D. Ventral neurons and dorsal neurons do not mix in the spinal cord, even at the midline. Name two possible reasons. (5 points) (2 sentences)

   E. There is a complex mouse mutant in which the entire spinal cord is composed only of ventral motor neurons. Explain how defects in dorsal and ventral patterning molecules could produce this. (5 points) (2 sentences)
3. (20 points total). A series of very short answer questions on the different sensory modalities.

One point per blank:

A. Number of opsin receptors______________________________________________

B. Number of T1R taste receptors___________________________________________

C. Number of T2R taste receptors___________________________________________

D. Number of mouse olfactory receptors_____________________________________

E. Number of olfactory receptors in one olfactory neuron_____________________

F. Number of T1Rs in a sweet taste cell______________________________________

G. Mice without rods and cones still have circadian rhythms. This is because they have the ______________ receptor in _______________________________ cells.

H. Male mice without the TRP ion channel in the VNO show altered sexual behavior. What is the behavior?_____________________________________________________

I. Mice with the taste-specific PLC only in T2R taste cells taste____________ and _____________ and ______________ compounds.

2 points per blank

On each line, list which sensory systems -- visual (V), auditory (A), olfactory (O), gustatory (G), or vomeronasal (VN) -- are accurately described by the statement.

A. Requires a GPCR _______________________________________________________

B. Cyclic nucleotide-gated channels _________________________________________

C. Ligand covalently binds to receptor ______________________________________

D. Receptors bind more than one ligand _______________________________
4. (20 points total) Mammalian taste cells are not neurons. Instead, neurons send dendrites to the taste cells and their axons go to the first gustatory relay in the brain. Imagine that you are a graduate student interested in understanding axon guidance of neurons from the tongue to the gustatory center in the brain. You look to see if any of the known axon guidance receptors are expressed in these neurons.

A. Name four guidance receptors that you would look for (4 points.)

None of the known axon guidance receptors is expressed in these neurons. After a lot of work and some good luck, you identify a receptor tyrosine kinase YUM that is expressed in neurons that contact sweet taste cells on the tongue and a ligand Y in the gustatory center. You suspect that YUM is an axon guidance receptor that recognizes Y in the gustatory center. You also believe that the taste system uses labeled lines to code taste information.

B. What is the labeled line model of taste coding? (6 points)

C. What would happen to the axons and to the mouse if you knock out Y (5 points)?

D. What would happen to the axons and mouse if you put YUM in neurons that contact cells expressing T1R3 (5 points)?
5. Hearing and vision both use very different signaling mechanisms to change the electrical activity of the sensory cells.

A. Hair cell activation opens a potassium channel, causing depolarization. Photoreceptors use a cation channel but light causes hyperpolarization. Explain how potassium channels depolarize hair cells and cation channels hyperpolarize photoreceptors. (7 pts) (2-4 sentences)

B. How does calcium affect phototransduction? Name two molecules that are regulated by calcium and their mechanism of action. (6 pts) (2 sentences)

C. Draw the voltage change due to a light stimulus in photoreceptors and a mechanosensory stimulus in hair cells. Be sure to show differences in the responses due to activation, adaptation and deactivation. (7 pts)