Student Number: _____

Name: _____

Date of Exam: _____

Place of Exam: _____

UNIVERSITY OF TORONTO
Faculty of Arts and Science

PSL 350H1S

Final Examination 2009

Duration: 3 hours

No aids allowed.

Section 1: 10 multiple choice questions (20 marks)

Section 2: 7 short answer questions for whole class (70 marks)

Section 3: 1 short answer question for subgroups (10 marks)

There are 18 questions.

There are 12 pages.

Print your name and student number on each page.

Invigilators are not permitted to interpret questions to individual students. If you think that a question is ambiguous, answer it as you understand it, then make a note on your question book. If you do so, print your name and indicate the question number on this page.

Name: **Student number:**

Section 1. Multiple choice questions (2 marks each). Circle the correct and only answer based on Philippe Monnier's lectures

Q1: To find their way towards target tissues axons require:

A- Guidance cues that will guide them towards the target area
B- A good substrate
C- Contact inhibitors to stop them from going in areas they should not go to
D- Both A and B
E- A, B, and C

Q2: If a guidance protein is inhibitory for one type of axons:
This protein will be:

A-inhibitory for all type of axons
B-inhibitory only for the axons that have the right receptor
C-never attractive
D-both A and C
E-both A and B

Q3: The Rho family of GTPases is:

A- Inhibited by RhoGEFs
B- Directly activated by a transmembrane receptor
C- Activated by ROCK
D- Activated by RhoGAPs
E- Activated by RhoGEFs

Q4: Proteins are often modified by sugars. These sugars:

A- May be involved in axonal guidance
B- Are necessary for cell surface targeting of the proteins on which they are located
C- Can be added in any portion of the protein regardless of the peptide sequence
D- Can be removed by enzymatic digestion to study their activity
E- E- A, B, C, and D
F- A, C, and D

Q5: Ephrin-B2 is expressed at the optic chiasm and force ipsilateral crossing of only a subset of axons why?

A-Because only these axons have the right receptor.
B-Because Ephrin-B2 is only expressed on this subset of axons when they cross the chiasm
C-Because Ephrin-B2 is repulsive and does not allow these axons to cross the chiasm.
D- both A and C
E- both B and C

Q6: To go to the cell surface a protein needs:

A- A signal peptide
B- A transmembrane domain
C- Some glycosylation
D- Both A and B
E- both B and C

Q7: Modifications that can be linked to the core protein via the –O- on the amino acid Serine:

A -Glycosylation
B -GPI-anchor
C- Phosphorylation
D- Both A and B
E- Both A and C

Q8: In your opinion a protein that has been modified by a translational modification may appear:

A- the same size as the unmodified protein in Western Blot analysis
B- Larger than the unmodified protein in Western Blot analysis
C- Smaller than the unmodified protein in Western Blot analysis
D- All the above
E- Both A and C

Q9: Protein cleavage

A- May be necessary to activate proteins
B- May change a repulsive protein into an attractive protein
C- Only happens when a signal peptide is removed when a protein is targeted towards the cell surface.
D- Never alters the function of a protein
E- A, B and C
F- A and B
G-B and C

Q10: Slit is an inhibitory guidance molecule for retinal axons, in some cases it is not repulsive on these axons. In which case?

A- When Slit is cleaved by a protease.
B- When Robo (the slit receptor) is not expressed by these axons?
C- When the molecular environment has been modified?
D- both A and B
E- A, B and, C

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Section 2: Short answer questions for whole class

Q1. What are the cellular difference between PNS and CNS? How do these cellular differences explain the different outcome when axons try to regenerate? (based on Philippe Monnier lectures, use space provided below, 10 marks).

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Q2. Compare and contrast the properties of adult stem cells versus embryonic stem cells (based on Freda Miller lectures, use the space provided below, 10 marks).

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Q3. Discuss the physiological role of one adult stem cell population (based on Freda Miller lectures, use the space provided below, 10 marks).

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Q4. A group of scientists would like to understand the cellular basis of a human genetic disorder that affects the nervous system. Give one example of how they could do so, starting with a skin biopsy from an affected patient (based on Freda Miller lectures, use the space provided below, 10 marks).

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Q5. Name five proteins that interact with AMPA glutamate receptors and describe the function for each protein. Assuming that these proteins directly bind to five distinct sites on the C-terminus of the GluR2 subunit, how would you test the in vivo function of each interaction and briefly describe your experiments? (based on Zhengping Jia's lectures, use the space provided below, 10 marks).

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Q6. What is the dendritic spine? How is it related to PSD, glutamate receptors, synaptic transmission and plasticity, and cognition? (based on Zhengping Jia's lectures, use the space provided below, 10 marks).

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Q7. What is the bacterial tTA/TeTO system? What is the Cre/LoxP system? How would you use these two systems to improve genetic manipulations in mice? Describe the advantages and disadvantage of each system (based on Zhengping Jia's lectures, use the space provided below, 10 marks).

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Section 3. Subgroup questions (Answer only your own group question, 10 marks)

Elena Comelli: The gut microbiota has been shown to modulate the intestinal barrier at the transcriptional level in the adult. Please briefly describe the experimental design, which techniques were used for global and gene specific expression analysis and which were their main outcomes.

Philippe Monier: Explain the gradient theory in the optic tectum. Using in vitro assays, how would you demonstrate that this theory is correct?

Shuzo Sugita: To elucidate the function of CAPS1 protein, Fujita et al. (2007) generated CAPS1 knockdown cells and found catecholamine secretion defects in these cells. These secretion defects in CAPS1 knockdown cells could be due to defects in either secretion machineries or other stages upstream of secretion, such as the loading of catecholamines into dense core vesicles. What kinds of experiments were performed by the authors to distinguish these two possibilities and what were the results of their experiments?

Jorgensen (2009): Satellite cells and Pericytes have been used to treat animal 'models' of Duchenne Muscular Dystrophy.

1) Where are satellite cells and pericytes located in adult mammals (be very specific!) and what is their function at the site of their location. **(2 marks)**
2) a. What experimental approach would you use to demonstrate that a sample of isolated cells are mainly composed of:
    i) satellite cells
    ii) pericytes
   and not contaminated with other cell types.
   Please explain your answer. **(4 marks)**
   b. Name the other cell types that might contaminate these two cell types. **(2 marks)**
3) What is mini-dystrophin and how and why was it used to treat animal 'models' of Duchenne Muscular Dystrophy. **(2 marks)**

Scott Heximer Group: 1). Describe the G-protein signaling and effector mechanisms used by the parasympathetic system to control heart rate at the level of the sinoatrial node myocytes (6 marks).

2). Describe how heart rate regulation would be expected to be different in an individual who had 5 times higher than normal expression of RGS4 in their sinoatrial node. Please discuss your answer with respect to the predicted regulation of both sympathetic and parasympathetic signaling (4 marks).

Richard P. Bazinet Group: During class the arachidonic acid hypothesis of bipolar disorder was presented. In the space below, please discuss the evidence supporting the role of arachidonic acid in bipolar disorder.

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Zhengping Jia Group: What are the major deficits of LIMK-1 knockout mice? Describe how LIMK-1 regulates spines and synaptic function.

Hiroshi Suzuki Group: Describe how the calcium sensor cameleon report calcium transients using the following key words: FRET, YFP, CFP, Calmodulin, YFP/CFP-ratio.