

Semester One Assessment 2006

Department: Anatomy and Cell Biology  
Subject Number: 516-306  
Subject Title: Developmental Neurobiology

Reading Time: 15 minutes

Writing Time: 2 hours

This paper has 3 pages

**Authorized materials:**

None allowed.

**Instructions to Invigilators:**

Script Books: 7 x 7 page.  
Exam paper may be removed from the exam room.

**Instructions to Students:**

Answer ALL 6 questions.  
**Use a separate script book for each question.**  
**Some questions have multiple parts. Answer ALL parts of each question.**  
The value of each question is indicated after the question.  
DIAGRAMS should be used wherever possible.

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**QUESTION 1:**

Discuss the role of Hox genes in the development of the vertebrate hindbrain. Your answer should deal with all of the following issues:

- a) The mechanism by which Hox genes regulate gene activity.
- b) The genomic organisation of Hox genes in vertebrates.
- c) The pattern of expression of Hox genes in the hindbrain.
- d) Experimental evidence in support of a role of Hox genes in rhombomere formation and specification.

(20 minutes)

**QUESTION 2:**

**Answer both parts a) and b) of this question.**

- a) Where do stem cells reside in the adult brain and where do they go when they differentiate?
- b) You want to test the effect of Factor X on neural stem cell function. Describe how you could use neurospheres for this purpose and state which neural stem cell parameters you would examine using the neurosphere system.

(10 minutes)

**QUESTION 3:**

Describe the role of one signalling pathway that influences the development of enteric neurons.

(10 minutes)

**QUESTION 4:**

**Answer all parts a), b) and c) of this question.**

- a) Discuss a current model for how an environmental factor can steer a growth cone in a particular direction. Your answer should explain how cytoskeletal rearrangements and growth cone-substrate adhesion are involved in such steering events.
- b) Give an example of a molecule that guides growing axons and describe **one** experimental finding that supports a role for that molecule in axon guidance.
- c) Discuss the identity, cellular origins and mechanism of action of several molecular factors that block regeneration of severed axons in the adult mammalian spinal cord.

(15 minutes)

(5 minutes)

(10 minutes)

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**QUESTION 5:**

Taking nerve growth factor as your example, discuss how neurotrophins regulate the number of neurons innervating a target tissue.

(20 minutes)

**QUESTION 6:**

**Answer both parts a) and b) of this question.**

a) During neural development in mammals, errors can occur in neural tube closure and in the proliferation and migration of neurons. Describe these defects, their possible causes and the outcome for the individual.

(15 minutes)

b) Synapses are overproduced during the normal development of the mammalian central nervous system and are then refined to form specific functional connections. Describe:

- i. The major morphological events occurring during synaptogenesis.
- ii. The factors thought to be involved in the process of synapse elimination. Use the visual system as an example.

(15 minutes)

**END OF EXAMINATION**