

516-201 Cell Biology: Tissues and Organs
Semester 1, 2004

The University of Melbourne
Semester One Assessment 2004

Department: Anatomy and Cell Biology
Subject Number: 516-201
Subject Title: Cell Biology: Tissues and Organs

Exam Duration: 2 hours

Reading Time: 15 minutes

This paper has 4 pages

Authorized materials:

None allowed

Instructions to Invigilators:

Script Books: 3 x 7 page.
The examination paper may be removed from the exam room.

Instructions to Students:

This examination consists of three parts - Part A, B and C.
Answer each part in a separate script book.

The Subject Number is 516-201. Ensure that you put the Subject Number and your Student Number on all script books used.

ALL 12 questions should be attempted.

The value of each question is indicated after the question.

LABELLED DIAGRAMS should be used wherever possible.

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PART A - 35 minutes

- Q1. Write short notes (no more than six lines in each case) on each of the following topics.
- a) Glycocalyx
 - b) Ion channels
 - c) Combinatorial control of gene expression
- (9 mins)
- Q2. Draw a labelled cross-section of the cell membrane showing the organization of the molecules that make it up. Explain why cell membranes can be described as two-dimensional fluids.
- (4 mins)
- Q3. Explain what determines the ability of an epidermal cell to respond to a signalling molecule circulating in the bloodstream. Why might an epidermal cell and a heart muscle cell respond differently on receiving the same signal?
- (4 mins)
- Q4. Outline the mechanism that regulates progression of the vertebrate cell cycle. Describe molecules that play key roles and indicate the function of these roles in cell cycle progression.
- (10 mins)
- Q5. Outline an experiment to show that a particular DNA sequence acts as a binding site for gene regulatory proteins that activate cardiac actin expression in a mouse heart.
- (8 mins)

PART B - 55 minutes

- Q6. Discuss the roles that the cytoskeleton and cell-substrate adhesion play in migration of a cell over a substrate consisting of extracellular matrix (ECM). Your answer should deal with the following:
- The different types of cytoskeletal molecules involved and how changes in their organisation assist the cell to move forwards.
 - Molecules involved in the formation of contacts between the cell membrane and the ECM and how these contacts change as the cell moves forwards.
 - In brief, what factors guide the migration of a cell in a particular direction.
- (15 mins)
- Q7. With the aid of a labelled diagram, describe the molecular structure of an adherens junction.
and
Describe how adherens junctions are involved in the bending of sheets of epithelial tissue during development.
- (10 mins)
- Q8. What features do adult stem cells and embryonic stem cells have in common and how do they differ?
- (7 mins)
- Q9. Draw a schematic diagram of the mucosal epithelium of the small intestine, labelled to show the following:
- a villus and a crypt
 - where epithelial stem cells are located
 - the region in which stem cell divisions occur
 - the region in which transit amplification divisions occur
 - the direction of movement of committed epithelial cells
 - the region in which epithelial cells differentiate
 - the region in which epithelial cells undergo apoptosis
- (8 mins)
- Q10. **Answer all parts of the following question.**
- Give an example of a signalling molecule that is involved in regulating cell proliferation or cell differentiation in **one of the following adult tissues**: mucosal epithelium of small intestine, epidermis, cartilage or bone.
 - Explain, in general terms, how reception of this signal at the membrane of the responding cell leads to the production of new proteins in that cell.
 - Give an example of one new protein that is produced by cells **in your chosen tissue** in response to that signalling molecule.
- (7 mins)

Q11. Answer all parts of the following question.

- a) List the major classes of molecules that make up the ECM.
- b) Compare and contrast the molecular composition and structure of the ECM in cartilage and bone.
- c) Explain how these different components account for the different physical properties of cartilage and bone.

(8 mins)

PART C - 30 minutes

Q12. Choose only ONE of the following two questions.

Either

- a) The gastrointestinal tract differs in its function down the length of the gut. How is the basic structure of the gut modified in the stomach and small intestine to carry out the functions specific to each of those parts of the gastrointestinal tract?

Or

- b) What role do leukocytes play in the defence of the body against invasion by a pathogen, such as a bacterium? Consider the role of leukocytes in either the innate or the adaptive immune system.

End of Exam