Self-Assessment in Histology

QUESTIONS AND QUIZ MICROGRAPHS

Paul R. Wheater
BA Hons (York), B Med Sci Hons (Nott), BM BS (Nott)
The Queens Medical Centre, University of Nottingham

H. George Burkitt

Self-Assessment in Histology

QUESTIONS AND QUIZ MICROGRAPHS

Paul R. Wheater
BA Hons (York), B Med Sci Hons (Nott), BM BS (Nott)
The Queens Medical Centre, University of Nottingham

H. George Burkitt
BDSc Hons (Queensland), M Med Sci (Nott), FRAC DS
School of Clinical Medicine, University of Cambridge

CHURCHILL LIVINGSTONE
EDINBURGH LONDON MELBOURNE AND NEW YORK 1981

CHURCHILL LIVINGSTONE
Medical Division of Longman Group Limited

Distributed in the United States of America by Churchill Livingstone Inc., 19 West 44th Street, New York, N.Y. 10036, and by associated companies, branches and representatives throughout the world.

First published 1982

ISBN 0 443 02109 0

British Library Cataloguing in Publication Data

Wheater, Paul R
Self-assessment in histology.
1. Histology — Problems, exercises, etc
I. Title II. Burkitt, H George
599.08'24'076 QM551 80-41293

Printed in Hong Kong by Sheck Wah Tong Printing Press Ltd

Preface

This book is not only intended for use by students revising for histology examinations, but also as an adjunct to the study of histology in general.

In principle, the most appropriate means of testing students' knowledge of histology is to use previously unseen quiz slides or photomicrographs. In practice this is usually economically prohibitive in a book of this type. We have however, been able to include a selection of thirty self assessment colour micrographs derived from material already published in our book *Functional Histology — a text and colour atlas* (Wheater P R, Burkitt H G, Daniels V G 1979 Functional Histology — a text and colour atlas. Churchill Livingstone, Edinburgh).

Since objective tests of the multiple choice or true/false format are being used increasingly for formal assessment, we have adopted this general approach in the preparation of the 800 questions. In keeping with our philosophy of teaching histology, the questions include relevant functional aspects of tissue structure. The questions have been designed not merely to assess but also to instruct and for this reason the usual strict examination format has not been slavishly followed and full explanations have been given in answer to all false statements.

It is hoped that this book will be useful for students using any histology textbook recommended by their teachers, nevertheless cross-references to *Functional Histology* have been given in brackets, e.g. (F.H. Fig 12.12) for topics we feel may pose particular problems to students. For the same reason, the order of questions closely follows the order of presentation of the chapter subject matter in *Functional Histology*.

Questions have been grouped in blocks of five referring to a single or related topics and it is suggested that students attempt all five questions of each block before referring to the answers. For ease of use, answers to questions are found immediately over the page rather than at the end of the section.

Finally, we express our gratitude to Mrs Christine Stevens for her meticulous typing of the manuscript.

Nottingham, 1980

Paul R. Wheater
H. George Burkitt

Contents

Part A

True/false questions and answers

1. The cell

Q1 The 'fluid mosaic' model of membrane structure proposes that the plasma membrane consists of a bilayer of phospholipid molecules separated by a layer of protein.

Q2 In general, hydrophobic (lipophilic) molecules are able to diffuse freely across membranes.

Q3 The cholesterol molecules which are associated with plasma membranes form the so-called glycocalyx of some eukaryotic cells.

Q4 The trilaminate appearance of the plasma membrane when viewed with electron microscopy is explicable in terms of the 'fluid mosaic' model of membrane structure.

Q5 Large molecular-weight polysaccharide molecules form 'dynamic pores' for transport of molecules such as sodium ions into cells.

Q6 Lipid-soluble molecules such as ethanol cross membranes by the process described as 'facilitated diffusion'.

Q7 'Facilitated diffusion' permits the transport of molecules across membranes against a concentration gradient.

Q8 The 'sodium pump' is an example of an active transport mechanism since it is effective against a concentration gradient.

Q9 Only active membrane transport processes are enhanced by increasing the plasma membrane surface area.

Q10 Phagocytosis is the reverse process of endocytosis.

Answers

A1 **F** The 'fluid mosaic' model proposes that the plasma membrane consists of two layers of phospholipid molecules; globular proteins 'float' at various levels in the membrane, some exposed to inner or outer environments, others spanning the whole thickness of the membrane. All membrane constituents may move laterally (i.e. they are fluid) in the membrane.

A2 **T**

A3 **F** Cholesterol molecules are located amongst the hydrophobic 'tails' of the phospholipid molecules in the middle of the membrane; the glycocalyx is composed of glycoproteins and glycolipids.

A4 **T** [F.H. p. 5].

A5 **F** The 'dynamic pores' consist of proteins (enzyme systems) incorporated in the plasma membrane.

A6 **F** Lipid-soluble molecules diffuse passively through the lipid component of membranes.

A7 **F** Facilitated diffusion only operates along a favourable concentration gradient but differs from passive diffusion by permitting passage of certain small molecules such as glucose which are not lipid soluble.

A8 **T**

A9 **F** All membrane transport processes are enhanced by increased surface area.

A10 **F** Phagocytosis is a form of endocytosis involving engulfment of particulate matter; when fluid matter is involved, endocytosis is often referred to as pinocytosis.

Q11 Primary lysosomes are electron-lucent structures bounded by a membrane.

Q12 Phagosomes are also referred to as lipofuscin granules.

Q13 Autophagy is one of the processes involved in the continuous turnover of cytoplasmic organelles.

Q14 Multivesicular bodies are a storage form of lysosomal precursors.

Q15 Alkaline phosphatase activity is a useful histochemical marker for lysosomes.

Q16 Cellular enzymes are subject to wear and tear and are continuously turned over, whereas structural proteins in the cell are completely stable.

Q17 Messenger RNA synthesis involves transcription of part of the genome.

Q18 Ribosomal RNA is synthesised in the nucleus.

Q19 Each ribosome consists of two subunits, one of which is composed of RNA and the other composed of ribosomal proteins.

Q20 Unlike messenger and ribosomal RNA, transfer RNA is synthesised by ribosomes.

Answers

A11 **F** Primary lysosomes are electron-dense structures (i.e. dark grey to black).

A12 **F** Phagosomes are vesicles containing engulfed material; lipofuscin granules are a brown-coloured form of residual bodies which accumulate in some tissues with increasing age or in certain pathological states. [F.H. Fig. 1.3].

A13 **T**

A14 **F** Multivesicular bodies are thought to be an unusual form of residual body.

A15 **F** Acid phosphatase is a characteristic histochemical marker for lysosomes.

A16 **F** All cellular proteins are turned over although at highly variable rates; structural proteins are, in general, turned over less rapidly than enzymes.

A17 **T**

A18 **T**

A19 **F** Both ribosomal subunits contain RNA and protein.

A20 **F** All RNA species are synthesised on a DNA template in the nucleus.

Q21 A cell without a nucleus could not be involved in protein synthesis.

Q22 The principal nuclear constituents are DNA, RNA and protein.

Q23 Heterochromatin represents that part of the genome which is actively involved in RNA synthesis.

Q24 Barr bodies represent a form of heterochromatin in the nuclei of cells from normal females.

Q25 A prominent nucleolus is usually indicative of a high degree of cellular metabolic activity.

Q26 The nucleus is bounded by two layers of membrane separated by a narrow space.

Q27 Radio-isotope labelling studies have shown that nucleoli pass from the nucleus to the cytoplasm via pores in the nuclear envelope.

Q28 The diameter of nuclear pores is about the same as that of mitochondria.

Q29 Ribosomes are often attached to the surface of endoplasmic reticulum but may also lie free in the cytoplasm.

Q30 Extensive rough endoplasmic reticulum is usually found in cells highly active in protein synthesis whereas extensive smooth endoplasmic reticulum is characteristic of cells highly active in lipid synthesis.

Answers

A21 **F** A non-nucleate cell could be involved in protein synthesis provided appropriate messenger, ribosomal and transfer RNA molecules were still present in the cytoplasm; e.g. in this way haemoglobin synthesis still continues in reticulocytes after extrusion of the nucleus during erythrocyte development.

A22 **T**

A23 **F** Heterochromatin represents that part of the genome relatively uninvolved in RNA synthesis (and thus protein synthesis); e.g. relatively inactive lymphocytes have a condensed nucleus mainly composed of heterochromatin.

A24 **T**

A25 **T**

A26 **T**

A27 **F** Nucleoli represent chromosome sites particularly active in RNA synthesis; chromosomes do not pass out of the nucleus.

A28 **F** Nuclear pores are very much smaller in diameter than mitochondria. [F.H. Figs. 1.7, 1.8].

A29 **T**

A30 **T**

Q31 Exocytosis is the usual means of secretion of proteins and other lipid-soluble materials.

Q32 The Golgi apparatus is a specialised area of rough endoplasmic reticulum involved in glycolipid synthesis.

Q33 The Golgi apparatus is responsible for packaging large molecular weight secretory products prior to their secretion by exocytosis.

Q34 Secretory products pass from the endoplasmic reticulum to the Golgi apparatus in the form of lysosomes.

Q35 The Golgi apparatus is characteristically located immediately beneath the plasma membrane.

Q36 Cellular respiration occurs in the cytosol, mitochondria and ribosomes.

Q37 Eukaryotic cells without mitochondria are incapable of aerobic metabolism.

Q38 The enzymes of the tricarboxylic acid cycle constitute the 'respiratory assemblies' and are located on the mitochondrial cristae.

Q39 Mitochondria are capable of protein synthesis.

Q40 Glycogen is characteristically stored within mitochondria where it forms so-called matrix granules.

Answers

A31 **F** Proteins are not lipid-soluble and are secreted by exocytosis; lipids diffuse out through the lipid component of the membrane.

A32 **F** The Golgi apparatus is a membranous organelle discrete from the rough endoplasmic reticulum; it is involved in packaging of proteinaceous or polypeptide secretory products prior to secretion, and the addition of the carbohydrate component in the case of glycoprotein or proteoglycan secretory products.

A33 **T**

A34 **F** Secretory products pass from the endoplasmic reticulum to the Golgi apparatus in vesicles known as transitional vesicles.

A35 **F** The Golgi apparatus usually lies deep in the cell adjacent to the nucleus.

A36 **F** Ribosomes are not a site of cellular respiration.

A37 **T**

A38 **F** Cytochromes are believed to be arranged as 'respiratory assemblies'; Krebs cycle enzymes are located in the mitochondrial matrix.

A39 **T** [F.H. Fig. 1.14].

A40 **F** Glycogen is stored in the cytosol; there is no evidence that mitochondrial matrix granules contain glycogen.

Q41 All cellular movement is principally mediated by rearrangement of the protein subunits of the glycocalyx.

Q42 Microfilaments consist of minute protein strands smaller in diameter than glycogen granules.

Q43 Microtubules are thought to constitute a specialisation of the endoplasmic reticulum.

Q44 Microtubules are of approximately the same diameter as microfilaments.

Q45 With electron microscopy, microtubules can be distinguished from microfilaments by their extensive branching.

Q46 Normal mitosis results in the production of two daughter cells which are genetically identical but which may not have identical cytoplasmic constituents.

Q47 In the cell cycle, the G_1 phase is the same as interphase.

Q48 After replication of the genome, the cell immediately enters mitosis.

Q49 A cell which is in the G_0 phase of the cell cycle may re-enter the cell cycle under appropriate circumstances.

Q50 Since the process of mitosis usually takes many days to complete, mitotic figures are observable in very large numbers in tissues made up of rapidly dividing cells.

Answers

A41 **F** The principal organelles involved in cell movement are microtubules and microfilaments.

A42 **T**

A43 **F** Microtubules are made up of globular proteins, not membranes. [F.H. Fig. 1.16].

A44 **F** Microtubules are of much greater diameter than microfilaments.

A45 **F** Microtubules are unbranched structures, much larger in diameter than microfibrils.

A46 **T**

A47 **F** The G_1, S and G_2 phases together make up interphase.

A48 **F** After the S phase, during which the DNA (the genome) is duplicated, there is an interval known as the G_2 phase before mitosis commences.

A49 **T**

A50 **F** Mitosis takes only about 30 to 60 minutes in mammalian cells and thus comprises only a short portion of the total cell cycle duration; even in tissues made up of rapidly dividing cells, mitotic figures are relatively few and far between.